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ABSTRACT

This collection contains studies of two large-scale national survey databases that have rich information on on-the-job training. The following papers are included: "On-the-Job Training/Sorting: Theory and Evidence," by John Bishop and Suk Kang; "The Magnitude and Determinants of On-the-Job Training," by John Bishop; "Impacts of Training," by John Bishop; "Substitutability of Work-Related Preparation and On-the-Job Training," by Suk Kang; "The Nature and Impact of Training: Evidence from the Current Population Survey," by Kevin Hollenbeck and Richard Willke; and "Implications and Policy Recommendations," by John Bishop. Seventy-eight data tables and eight figures are included. (MN)

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TRAINING AND HUMAN CAPITAL FORMATION

John Bishop
Kevin Hollenbeck
Suk Kang
and
Richard Willke

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FOREWORD

Very little is known about the character of employer training policies and how they influence worker's productivity. To address these and other issues, the National Center for Research in Vocational Education commissioned the Gallup Organization to conduct telephone interviews with over 3,800 employers. This report is one of a series of papers analyzing how employers train employees and the effects of employer training on the economy.

We wish to express our gratitude to the Education and Training Division of the U.S. Department of Labor for funding this research. We wish especially to thank Dr. Ray Uhalde, Project Officer, for his assistance during various stages of the effort. The research program on employer training behavior also received funding from a number of other sources, and we wish to acknowledge the support from the National Commission for Employment Policy, the U.S. Department of Health and Human Services, the W.E. Upjohn Institute for Employment Research, and the Swedish Institute for Social Research for supporting earlier stages of the research effort.

This research would not have been possible without the cooperation and assistance of 3,800 employers who so graciously responded to our telephone interviews. We greatly appreciate the time and the insights that these very busy people contributed to the study.

We are indebted to the many people who assisted in the design of the interview instruments. In this regard, special thanks are due to Dr. James Medoff, Professor, Harvard University; Dr. Frank Stafford, Chairman of the Department of Economics, University of Michigan; Clifford Roe, Supervisor of Salaried Union Relations and EEO Administrator (retired), Buffalo Divisions, Westinghouse Electric Corporation; and Dr. William J. Dennis, Research Director, National Federation of Independent Business. Wilson S. Johnson, President, the National Federation of Independent Business, was very supportive of the study and graciously provided a letter of introduction that we sent to all the employers selected for an interview. Thanks are extended to the staff at the Gallup Organization who supervised the telephone survey: Mitchell Cohen, Nancy Nygreen, Peggy Ashton, and Corinne Kyle.

Reviewers of earlier drafts of various parts of this report--Dr. George Borjas, associate professor, University of California-Santa Barbara, and Dr. Masanori Hashimoto, associate professor, University of Washington--made many helpful suggestions. Student research assistants who worked on the computing and data processing effort were Yoen-Seung Chung, Bruce Smith, Jamal Ershadi, Kevin Landin, and Steve Wilson. The manuscript was edited by Janet Kiplinger, Judy Balogh, and Ray Stewart and was typed by Debbie Fladen, Cathy Jones, Colleen Kinzelman, Vera Mueller, and Angela Valentine.

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EXECUTIVE SUMMARY

Every year employers and employees jointly invest a massive amount of resources in on-the-job training. Despite its importance, very little is known about the determinants of on-the-job training, its magnitude and distribution, its impact on productivity, and its relationship with wage rates, earnings, and labor turnover. This report contains studies of the two large-scale national survey databases that have rich information on on-the-job training. The first is the National Employer Survey that has detailed data on training activities and productivity measures, and the second is the supplement to the 1983 Current Population Survey.

In the past, the absence of data containing direct measurement of time devoted to on-the-job training and the productivity of individual workers has forced economists to treat both on-the-job training and its primary outcome, improvement in productivity, as unobservable. Training has had to be proxied by imperfect indicators such as tenure on the job or a proxy for work experience defined as years since the completion of schooling. The only outcomes that could be studied were wage rates and turnover.

Studies consistently have found positive associations between tenure and wage rates. Human capital theory explains these associations as arising from training which causes productivity to rise and, therefore, the wage rate to rise. However, the implicit assumption behind this logic, that wage rate coincides with the worker's marginal productivity, is not necessarily supported by the data. Indeed, some empirical work (Medoff and Abraham 1981) rejects a one for one relationship between wage rates and productivity.

In order to examine the effects of training on productivity, direct measurements of training and productivity are needed. The first four chapters of this report examine the various outcomes and determinants of on-the-job training in the early period of employment from a unique data set that contains direct measurements of training activities and productivity growth from a survey of 3,800 employers conducted in 1982.

In the first chapter, a theoretical model of the firm's training decision is presented and its prediction on wage-productivity profile is tested. Chapter

2 describes the magnitude and distribution of on-the-job training. In chapter 3, various outcomes of on-the-job training, productivity, wage rates, labor turnover, and promotion are analyzed, and in chapter 4, the returns from training are estimated from disaggregated data classified by the six occupational groups. In chapter 5, data from the 1983 Current Population Survey is analyzed to describe the distribution and effects of training. Finally, chapter 6 discusses policy implication derived from the analyses.

The theory explains the determination of on-the-job training and the compensation package that distributes the cost and return from the training. It is assumed that (1) there are two distinct types of skills, general and firm specific, that are produced jointly; (2) the training firm can accurately measure the amount of general training received by its workers, but other firms cannot; (3) workers are not able to borrow money at as attractive rates of interest as their employers; and (4) the compensation offered by a firm has a bigger effect on a job seeker's decision to take a job than on whether to quit a job at a later time. These assumptions about the environment in which training and compensation decisions are made are combined with a model of the competitive labor market. We get the following predictions about time pattern of compensation.

- Employers bid for new employees by offering front-loaded compensation packages. Since most workers have a stronger desire to have a dollar now rather than later, the firm can use its borrowing power to offer new employees a wage package that pays in advance of performance. Moving allowances are a clear example of this phenomenon, but the same thing is also accomplished by offering higher starting wages and by raising wages with tenure by less than the rise in the productivity net of training costs. The tendency of firms to front-load compensation is greatest when quit rates are not very responsive to the second period wage and when there is a big difference between the worker's and the employer's ability to borrow.

- Compensation tends to be front-loaded if the people who stay at a firm find that the attractiveness of alternative jobs falls with tenure on their current job. The factors that have this effect are costs of job search or job changing, an underestimate by other employers of the amount of general training received, and the tendency of those with the better alternatives or the greater dissatisfaction with their current jobs to leave and of those with less attractive alternatives and greater satisfaction with their current jobs to stay.

- Front-loading of compensation is greater when the second period wage has a greater proportionate impact on the probability; and the employer will keep a worker that he or she has on the probability the worker will want to stay.
- Anything that raises productivity in the firm but does not raise it outside the firm, will raise the wage in the second period, bu not by as much as productivity at the firm increases. Two factors producing this effect are training that is specific to the needs of the employer and the ability of the firm to fire the least productive employees. Here again the result is a front-loaded wage package.
- General training, which raises productivity both inside and outside of the firm equally, results in wages being increased along with the rise in productivity net of training costs. Post-training wage rates will have to be higher, and starting wage rates will consequently be lower by a compensating amount.

A front-loaded compensation package means that at first the firm is investing more in training. Later in the worker's tenure, these investments pay off, and the employee's output exceeds the wages paid. If the worker quits before the return from the investment is recouped, the employer incurs loss.

Theory predicts that most compensation packages will be front-loaded, or in other words, wage rates will rise more slowly than productivity net of training costs when training is entirely general. This prediction contrasts with the predictions of Becker's theory of general human capital, Lazear's agency model, Jovanovic's sorting model, and Salop and Salop's self-selection model. These models all predict that when training is general, wages will rise at a rate that is at or above the growth rate of the productivity net of training cost. Data on the generality of the training offered and on the growth of wages and productivity of 1,493 recently hired workers were used to test these competing theories.

Training seems to increase the productivity of new employees. During the first 2 weeks, the typical new employee at firms offering general training is reported to be only 59-60 percent as productive as the typical worker with 2 years of tenure and experience. During the next 10 weeks at the firm, the typical new employee's productivity is reported to be 79 percent that of a worker with 2 years of tenure. The reported productivity of new employees increases more rapidly in the first month or so than it does later. Estimates of the ratio of the worker's productivity after 2 years of tenure in the job were made by combining these productivity ratios with the earlier reported estimates of training investments. The central hypothesis that the productivity net of training costs rises more rapidly than compensation, even when training is reported to be completely general, was then tested under a variety of assumptions about the appropriate scaling and measurement of productivity net of training costs. These tests produced a decisive rejection of the hypothesis that compensation for jobs reported to offer completely general training rises at a rate that is equal to or greater than the rise in the productivity net of training costs.

The theory also makes some important predictions about the determinants of investment in on-the-job training:

- Firms and workers will invest more in general or firm specific training when interest rates are low, when separation rates are low, when other employers recognize the quality of a firm's training, and when costs of investment are deductible in the year incurred.

- Decisions about the provision of specific human capital investments depend upon the interest rate the firm must pay to borrow money. The fact that the costs and benefits of specific human capital investments are shared does not mean that decision making about the amount of specific training is shared. The interest rate the employee faces does not affect the decision.

- When the quality of general OJT provided by an employer is not accurately perceived by other potential employers, the costs and benefits of the training are shared between employer and employee. Also, the level of investment is influenced by the rates of interest faced by both the employer and the employee.

- Workers and firms tend to underinvest in general training. This occurs for three reasons.

    --The workers either cannot borrow to pay for their on-the-job training investments or must pay extremely high interest rates on any money they might borrow.

    --Other employers do not accurately perceive general OJT received by the worker and as a result do not fully compensate the trained worker even if he or she receives good training.

--If a minimum wage constraint is binding, the starting wage on a job will have to be higher than it would otherwise have been. This increases the cost of training and thus reduces the amount of training. A second impact of the minimum wage is that the rise in the starting wage is partially compensated for by a fall in the wage rate in the post-training period. This increases the quit rate, which in turn reduces the payoff to training and, therefore, the amount of training.

- If the interest rates facing employers are higher than the social discount rate, there will also be underinvestment in specific training. The degree of underinvestment in specific training is considerably smaller than the underinvestment in general training.

The magnitude and determinants of on-the-job training, productivity growth, and the rate of wage growth are examined using the National Employer Survey data in Chapter 2. Cross tabulations are presented by occupations, establishment size, industry, relevant work experience, age, and schooling. The following patterns are found from the tabulations:

- During the first 3 months, new hires spend an average of 49.3 hours watching others do the job, 10.7 hours in formal training programs, and 51 hours receiving informal training by co-workers.

- Occupation has a big effect on the amount of training that new hires receive. During the first 3 months, the time devoted to training a service worker is equal in value to 20 percent of that worker's potential productivity during the period; the percentage is 38 percent for blue-collar jobs, 45 percent for clerical jobs, and 50 percent for professional, managerial, and sales jobs.

- Productivity of new employees increases quite rapidly. The rate of growth is roughly one third in the first 3 months. In low-skill occupations such as blue-collar, service, clerical, and sales jobs, growth rates in productivity from the 4th month through the end of the 2d year, however, are much smaller than in the first 3 months. In the high-skill occupations, professional and managerial jobs, productivity growth continues after the first few months at a higher rate than in low skill jobs.

- Training investment is large at both ends of the establishment size distribution. Large firms (more than 200 employees) and small firms (less than 10 employees) devote more time to training than do the medium-sized firms.

- Productivity growth shows a positive association with establishment size. The smallest firms show a 29 percent increase by the end of the first 3 months and a further 26 percent increase over the course of the next 21 months. The largest firms report a 49 percent increase in the first few months and a 34 percent increase during the next 21-month period.

- Training investment shows large variation across industries. Mining, retail, and construction industries provide the least training. The industries that offer the most training are finance, wholesale, and manufacturing. Industries that offer more training also seem to experience larger increases in productivity.

- New employees with more schooling and vocational training take jobs that require and offer more intensive training. Those who have received college degrees receive 40 percent more training than those who have only a high school diploma. Furthermore, those who do not complete high school receive 40 percent less training than high school graduates.

In order to examine the determinants of training, multiple regressions were also estimated. The two indicators of training included a measure of training requirements--the log of weeks to become fully trained when the workers do not have any previous work experience--and a measure of training intensity--the log of the training index in the first 3 months of employment.

The factors that had significant positive associations with training requirements were the following:

- Importance of vocational education
- General education requirements for the job
- Value of capital used in the job
- Full-time work
- Weekly work hours

Significant variations in training requirements were also found across occupations and in response to the proportion of the firm's work force--white-collar workers and craftsworkers.

New employees experience dramatic improvement in productivity in the first 2 years of employment at a firm. A part of this productivity growth is due to learning by doing and would occur even if no training is provided. Formal and informal training are responsible for a major portion of the productivity growth, however. What is the rate of return to these conscious efforts to train new employees? Which training methods are most effective?

Our study of the impact of training on productivity growth found the following:

- The marginal rates of return to training are apparently very high, averaging about 30 percent. However, the rate of return decreases as the intensity of training increases.
- Evaluated at the sample mean values, informal training by co-workers has the highest rate of return. The rate of return from the other three types of training is in descending order as follows: watching others do the job, informal on-the-job training by management, and formal training by management. However, the returns from training vary by establishment size. In large establishments, formal training by management tends to have a higher return and informal training and watching others are less effective than in smaller firms.
- Under the assumption that training is simultaneously determined with productivity growth, the estimated return from training from the two stage least squares models is much higher than that obtained from the ordinary least squares models; however, the statistical significance of all coefficients diminishes as well.

The theory presented in the first chapter predicts that jobs with a great deal of training will tend to have lower starting wage rates and higher wage rates once the training is completed. In the second section of chapter 3, this prediction is tested by regressing wage growth in the first 2 years on the training variables, after controlling for various worker, firm, and job characteristics. The results show significant positive associations between training and wage growth. Furthermore, the growth of wage rates due to training is much smaller than the productivity growth due to training, supporting another prediction of the theory. An additional 100 hours of training raises productivity of typical employees by 10-20 percent but raises the wage rate by only 2.6 percent. This result confirms empirical findings presented in chapter 1 on front-loaded wage profiles which is based on simple bivariate analyses.

Employers place high priority on hiring individuals with relevant work experience and relevant occupational training. This behavior is based on a belief that those who have had previous training are likely to be more productive and to require less training. Are these beliefs justified? By comparing individuals entering the same job at the same firm who have different amounts of previous relevant experience and job training, the beliefs were tested. The main results from the analysis are the following:

- Relevant work experience significantly increases the productivity of new hires and reduces the time required to train them. Five years of relevant experience raises productivity by 25 percent in the first 2 weeks, by 15 percent over the next 10 weeks, and by 8-9 percent at the time of the interview. It also reduces training by one-third and raises the productivity net of training cost during the first 3 months by 44 percent.

- Five years of experience considered irrelevant by the employer is associated with productivity being lower by 3-6 percent, but it does not have any significant effects on training time or turnover. It is, however, associated with higher wage rates. The effect of irrelevant experience on wages is about one-third the effect of relevant experience.

- Starting wage rates are 6.4 percent higher for those with 5 years of relevant experience. This additional cost to the employer, however, is considerably smaller than the benefit of hiring such a worker--a 44 percent increase in productivity net of training cost in the first 3 months.

- Workers who have had vocational training that is not relevant to the job are slightly less productive in the first 2 weeks and required slightly more training than people who have had no vocational training. Workers who had had relevant vocational training are significantly more productive both initially and at the time of the interview and also require less training than those with no vocational training.

- The effects of relevant vocational training are largest for those with 1-3 years of college. It increases productivity in the first 2 weeks by 13 percent, reduces management training time by 35 percent, and reduces overall training time by 22 percent. Vocational training at these institutions produces small increases in quit rates, moderate reductions in involuntary turnover, and small increases in tenure. Overall, productivity net of training cost during the first 3 months increases by 22 percent, and wage rates are 8 percent higher for those with relevant vocational training.

One-fourth of the total variation of training intensity is found in variation across people occupying the same position at the same firm. Firms recognize that some new hires require more training than others and adjust their training efforts accordingly. Workers with previous work experience and relevant vocational training require and get less on-the-job training. Those viewed as more promotable often get more training to prepare them for the broader responsibilities they will have in the future. When the company and the job for which the worker is being trained are held constant, what impact does variation in training have upon productivity wage rates, turnover, and promotions? The last 4 sections of chapter 3 address each of these issues in turn. the analyses are based on the comparisons of two different workers hired for the same position at the same firm.

Main findings from the analyses of effects of training on productivity are as follows:

- Training has significantly larger effects on productivity at large firms than at small firms. The elasticity of productivity with respect to training is 0.14 at companies with 19 employees and 0.36 at companies with 200 employees in the logarithmic model. The magnitudes of elasticity are smaller in the linear model but the relative effects of firm size do not change.
- Training received from supervisors has considerably smaller effects on a worker's productivity than the training received from co-workers or through other formal mechanisms.
- The effects of training and learning by doing on productivity decrease if the worker has had relevant training in private training institutions. This suggests that training provided by these institutions is a close substitute for employer-provided on-the-job training.

The next issue, addressed in the fifth section, is whether firms adjust the wage rate to reflect the individuals' productivity and training requirements. Holding the job constant, offers of starting wage rates and the current wage of job incumbents are expected to depend on worker characteristics such as schooling, work experience, and gender, which also influence worker's productivity. Is the dependence a function of wage setting based on the firm's prediction of worker productivity or on the observed productivity?

In order to examine the extent to which wages reflect actual differences in productivity, starting and current wage rates are regressed on realized relative productivity scores, an index of the training, and other worker characteristics. The results show that (1) no significant association exists between starting wage and initial or future productivity; (2) more training provided is associated with lower starting wage; (3) worker characteristics have a significant impact on the starting wage; (4) the current productivity has a positive effect on current wage rate, but productivity in the first 3 months does not have any significant impact on the current wage rate; and, (5) the elasticity of the wage with respect to producitivity is below .2.

These results suggest that employers adjust wage rates to available information regarding each worker's productivity. In determining the starting wage rate, the source of information is worker characteristics, which are the best, though imperfect, predictors of worker's productivity in the early employment period. Later, the weight placed on those characteristics declines and wage rate is adjusted mainly to observed productivity but the adjustments only partially capture the differences in productivity.

The next issue is, What impact does the productivity of a worker and training received by that worker have upon turnover? A worker's performance is only partially reflected in wage growth. Employers may also respond to productivity differentials between workers by promoting the most productive and firing the least productive. How responsive is turnover to productivity differentials? The impact of training and productivity on turnover was examined and the main finding were the following:

- Higher productivity in the early period of employment is associated with lower probabilities of both voluntary and involuntary separation and longer expected tenure. Less productive workers are more likely to quit, but it is in the probability of being fired or laid off where large differences show up.

- Turnover is less responsive to productivity differences in large unionized firms. One standard deviation increase in productivity score raises expected tenure by 27 percent at small nonunionized firms; by 13.5 percent at large, non-unionized firms; and by 6.7 percent at large, unionized firms.

- Training seems to have a positive effect on expected tenure. The elasticity of tenure with respect to training is about 0.12.

The final section of chapter 3 examines the impact of productivity and training on promotions. About one-third of our sample of new hires was promoted before the date of interview. The variable with the largest impact on promotion was productivity during the 3d-12th weeks of employment. Those who were 15 percent more productive in this period were 13 percent more likely to be promoted. Low productivity in the first 2 weeks, however, does not influence a firm's promotion decision. Also, workers who receive more training are more likely to be promoted. This association is stronger at larger establishments.

We have just seen that those who receive more previous training are more productive in the first few weeks of employment. If previous work-related training is complementary to on-the-job training, the firms will invest more resources in training these better prepared workers. On the other hand, if previous work-related preparation is replaceable by on-the-job training to raise productivity, the firms tend to invest more in training less prepared workers. The degree of substitutability depends on the technology employed by the firm, industry, and occupation. In chapter 4, in order to examine the degrees of substitutability across occupations, the data are analyzed by disaggregating them into six occupational groups--clerical, sales, service, retail, crafts, and management. The relationship between training activities and productivity growth is examined under the hypothesis that within the same occupational group, productivity scores are measured in comparable units.

In order to examine the substitutability of on-the-job training and previous work related preparation, three models describing firms' training decisions and their predictions of on-the-job training and productivity growth are presented. The first model assumes complementarity, the second model assumes substitutability, and the third model assumes independence. The estimation results support the prediction of the model in which previous training and on-the-job training are assumed to be substitutes. Specifically, the following is found:

- Those who are more productive in the very beginning of employment tend to receive less training in the first 3 months of employment.
- Across occupational groups, the marginal return from training is high if the new hire's initial productivity is low, and it is low if the new hire is more productive in the beginning.

These findings suggest that in the first 3 months or so of employment, it pays for firms to invest more resources in training less productive workers than to invest resources in training workers with higher initial productivity. In other words, low productivity in the initial stage of employment can be compensated for by on-the-job training.

Also, variations in the marginal return are found across the six occupational groups. Occupations that require more training--crafts and management--tend to have lower return from on-the-job training measured as improvement in productivity. In the low-skill occupations--clerical, sales, service, and retail--the marginal returns are high. This result, however, should be interpreted with caution because of the short time period over which training was measured.

In chapter 5, 1983 Current Population Survey training supplement data are examined. The analyses focus on the determinants of the prior training before obtaining the job and on-the-job training after joining the firm, and on association between training activities and earnings.

The supplemental survey asked workers whether they needed specific skills or training to obtain their current (last) jobs and, if so, whether this training was obtained from a school, formal company training, informal on-the-job training, the armed forces, a correspondence course, or other sources. These workers were also asked if they had taken any training to improve their skills since obtaining their present jobs and, if so, how that training was received.

The first section of chapter 5 presents cross tabulation analyses of the relationships between individual characteristics and these two types of training. Major findings from the tabulations are as follows:

- Approximately 54 percent of respondents needed specific skills or training to obtain their jobs; about 35 percent had taken skill improvement training in their current jobs.

- Informal OJT was mentioned most often as a source of qualifying and skill improvement training. It was listed as a source for 51 percent of the individuals who had needed qualifying training and 41 percent of the individuals who reported skill improvement training.

- Schools were a source of qualifying training for 50 percent of the respondents who needed such training to obtain their jobs and 33 percent of skill improvement trainees. Among school-based programs, 4-year or longer college programs accounted for the largest share of school-based qualifying and skill improvement training.

- Training in a formal company program had quite different characteristics from school-based programs. It was shorter in length and comprised of fewer courses. Most of such training was taken off-site--55 percent for formal company training that was reported to be qualifying training and 67 percent for skill improvement training.

- The following common patterns were observed between individual characteristics and the likelihood of reporting training. These relationships did not change even when differences in occupations were taken into account:

  --Age of worker had a curvilinear relationship with training likelihood in which prime age (25-44) individuals had the highest likelihood of reporting training

  --Blacks reported significantly less training than other races

  --Males and females had similar likelihoods of reporting training; although females had fewer sources of school-based training

  --There was a strong positive relationship hold between education and reported training

  --Workers in the West had more training than the workers in other U.S. census regions.

  --Job tenure was positively associated with training.

- About 3 percent of the respondents who had training received it through a government program such as CETA. Over 6 percent of blacks who reported training had obtained it in government-sponsored programs. Over 5 percent of workers inservice occupations and almost 9 percent of workers in the government sector who reported training received it through government-sponsored programs.

- Employers paid for about 19 percent of school-based training.

In the second section of chapter 5, the determinants of participation in qualifying training and at-job-training (skill improvement training received on the job) are examined. Dummy variables for participation in the two types of training were regressed on occupation dummies, industry dummies, and an extensive list of variables representing socioeconomic status, demographic characteristics, schooling, and work experience. Also, the effects of training on earnings were examined by regressing earnings on dummies for the two types of training and other various worker characteristics. Major findings from the analyses are the following:

- Occupations that require more qualifying training also tend to provide more skill impriving training on the job. The occupational categories with high likelihoods of training are health-related occupations, educator, scientists, sales representative, finance occupations, and business occupations. Occupations that require less qualifying training and provided less skill improvement training are construction laborer, helpers, cleaners, and freight, stock, and material handlers.

- Among industries, justice, public order and safety, and national security are most likely to require qualifying training and to provide skill improvement training.

- There is a high correlation between an occupation's or industry's likelihood of requiring qualifying training and its likelihood of offering skill improvement training.

- Female non-heads of household, whites, those married with spouse present, veterans, self-employed workers, and those living inside standard metropolitan statistical areas are more likely to receive qualifying and skill improvement whereas male non-heads of household, Hispanics, part-time workers, and those who never married were least likely to receive training. Since the sample includes only those currently employed, some of these results may be attributed to sample selection effects.

- Years of schooling through the master's level increase the probability of skill improvement training. There did not seem to be a sheepskin effect from getting the high school diploma or the college degree.

- Any experience at the current firm increases the probability of receiving skill improvement training, but any non-firm experience, including that in the current occupation, reduces that probability, particularly for males.

- In regression models controlling for demographic variables, years of schooling, and experience, full-time workers with only qualifying training have 16 percent higher earnings, those with only skill improvement training have 12.9 percent higher earnings, and those with both types of training had 22.2 percent higher earnings. When occupation and industry are controlled for as well, these figures fall somewhat to 10.5 percent, 8.8 percent, and 15.8 percent, respectively.

- Controlling for training increases the earnings advantage of being male from 14.1 percent to 16.3 percent, and decreases the earnings advantage of being white (vs. black) from 8.0 percent to 6.4 percent. Controlling for occupation and industry as well reduces the male effect back to 14.1 percent and further reduces the white effect to 3.4 percent.

- The individual effects of types of qualifying training on earnings are 6.3 percent for schooling, 9.8 percent for formal company training, 9.7 percent for informal OJT, 4.8 percent for armed forces training, -2.5 percent for correspondence courses, and 5.7 percent for other training. For skill improvement training types, the earnings effects were 10.4 percent for schooling, 10.8 percent for formal company training, 4.6 percent for informal OJT, and 6.9 percent for other training. Those with more than one type of training generally have a net earnings effect that is somewhat higher than the sum of the individual effect.

- Among significant features of qualifying training in the form of schooling, high school vocational programs reduce current earnings by 4.7 percent, 4-year college or university schooling increases earnings by 4.7 percent, and completing the program increases earnings by 4.8 percent. Apprenticeship programs in qualifying formal company training increase earnings by 7.9 percent. Employer-paid skill improvement schooling is related to a 5.0 percent higher earnings and CETA-type skill improvement schooling to 8.9 percent higher earnings. However, CETA-type skill improvement provided through formal company training reduce earnings by 10.4 percent.

- Years of college- and master's-level work increase earnings whether or not they are considered qualifying or skill improvement training, and post-master's work increases earnings if it is qualifying training, but decreases current earnings if it is skill improvement training.

- The presence of qualifying formal company training reduces the earnings return to years of experience in the current firm and occupation, but that same return is increased by the presence of skill improvement school training.

The last chapter, Chapter 6, discusses policy implications derived from our analyses in the previous chapters. From the point of view of public policy, the most important conclusion from the analysis of on-the-job training is that employers and employees underinvest in general on-the-job training. This occurs for five reasons:

- Other employers receive some of the benefits of the training.

- Other employers do not perceive accurately the quality of the general OJT received by the worker and, as a result, do not fully compensate the trained worker if he or she receive good training.

- The worker's discount rate is considerably higher than the social discount rate. This occurs because workers typically cannot borrow at reasonable interest rates to finance consumption while they are receiving training in the early stage of employment.

- The tax rates faced by the worker when the returns to the investment are being received are typically higher than the tax rates when the costs are being incurred.

- If a minimum wage constraint is binding, the starting wage will have to be higher than it would otherwise have been, and this increases the cost of training and thus reduces the amount offered. A second impact of the minimum wage is that the rise in

> the starting wage is partially compensated for by a fall in the wage rate in the posttraining period. This increases the quit rate, which in turn reduces the payoff to training and therefore the amount of training.

The first section of chapter 6 presents empirical evidence that workers getting paid the minimum wage tend to receive disproportionately less training than workers whose wages are above the minimum. It is found, when the minimum wage constraints are binding, that paying the minimum reduces training intensity by an average of 25 percent. Productivity growth is lower as well. Binding minimum wage constraint is associated with lower productivity by about 5 percent in the post-training period. Also, it reduces the growth of productivity by 12-17 percent.

If there is underinvestment in general OJT, we would expect to find private rates of return to OJT to be very high. Indeed, the studies that have estimated the return to OJT investments by workers find that rates are very high. For instance, after adjusting for inflation, the real rate of return to OJT investments by the worker is 12.6 percent per year for those who went to college and 19 percent for those who did not attend college (Rosen 1982). These rates of return are considerably higher than the real rates of return of about 4 percent on corporate bonds and of about 5 percent for schooling. Additional evidence comes from the fact that the employers interviewed in the 1982 survey report that new hires are 32 percent more productive on average in the 3d-12th weeks of employment than in the first 2 weeks. This implies that the average rate of return for this training exceeds 100 percent. Employers also reported that productivity typically increases another 26 percent over the course of the next 21 months.

How might the government induce firms and workers to increase investment in general on-the-job training? Since the returns to training cannot be distinguished administratively from other labor earnings and profits, lowering the rates of taxation on these returns is not a feasible policy option.

Policies promoting general on-the-job training either remove artificial barriers or subsidize the costs of the investment. Nine different approaches to increasing on-the-job training are discussed.

- The lowering of labor turnover is one approach. The investment in training during the first 3 months has an average value equivalent to 1.5 months of output by an experienced worker. When a separation occurs, much of this investment is lost, for most of the skills taught are either not useful at other firms or are not recognized and rewarded by other firms. The fear of losing one's investment depresses training. Turnover would be reduced if job seekers were better informed about the jobs they are applying for and employers were better informed about the applicants they are hiring.

- A second approach is to educate youth to seek out jobs that offer training and opportunities for upward mobility and to encourage them to deemphasize the starting wage in making decisions about where to work.

- A third approach is to inform job applicants of the training that will be provided by various employers. School placement officers and other placement personnel should learn about the training that is provided by different employers and should share this information with their students and use it in steering them to employers.

- A fourth approach is to encourage firms to increase their hiring of inexperienced workers and the training that is provided to them. The worker would share in the costs of this training by starting at a lower wage. The wage would be raised as the worker's skills improved.

- A fifth approach is to improve current systems of certifying the quality of on-the-job training. The best way to accomplish this would be by offering industrywide competency-based training and certification like that currently existing in banking and construction.

- A sixth approach is to allow jobs that offer considerable general training to pay wage rates below the legal minimum.

- A seventh approach is to make workers who are undergoing a significant amount of general on-the-job training eligible for low-interest guaranteed student loans.

- An eighth approach is to encourage public educational institutions to provide more training at the work site that is customized to the needs of the particular employer.

- A ninth approach is to provide government subsidies of on-the-job training. This might be accomplished by--

  --expanding JTPA's OJT training contracts,

  --making TJTC funding depend on the amount of training provided,

  --offering government subsidies for training of skills that are in critical shortage,

  --offering a tax credit for increases in training expenditures above 1 or 2 percent of the firm's wage bill, and

  --taxing firms that do not spend at least 1 percent of their wage bill on training.

1.0 ON-THE-JOB TRAINING/SORTING: THEORY AND EVIDENCE

John Bishop and Suk Kang

1.1 Introduction

Every year employers and employees jointly invest a massive amount of resources in on-the-job training (OJT). Despite its importance, however, very little is known about it's magnitude, its distribution, and its effects. The absence of data containing direct measurement of the time devoted to OJT and the productivity of individual workers that receive OJT has forced economists to treat both OJT and its primary outcome, greater productivity, as unobservables. Training has had to be proxied by imperfect indicators such as tenure on the job and experience, and the only outcomes that could be studied were earnings and turnover.

The unsatisfactory nature of the empirical work in this area is accentuated by the variety and richness of the theoretical developments. The theory of on-the-job training accepted by most economists starts with the observation that training develops two distinct types of skills: general and specific. Specific training raises the worker's productivity in the organization providing the training, but this training cannot be applied in other organizations. General training raises a worker's ability to be productive in other organizations as well as the one providing the training.

As workers receiving general training become more productive, the firm will raise their wages to keep them. Since the workers get the benefits of the training, not the firm, a firm will not be willing to pay any of the costs of general training. Thus, the competitive firm that provides only general training will offer, during the training period, a wage equal to the value of the marginal product of the worker minus the cost of the training. Some workers will volunteer to work during training at this wage, even if it is below what could be earned elsewhere without the training, because it will mean a higher wage later.

The theory predicts that the costs and the benefits of specific training are shared by the employees and their employer. Workers who receive specific training will not be offered comparable wages by other firms because the productivity of that worker will be higher in the firm in which specific training is received than in another firm. Therefore, firms offering this type of training can recover part of the training cost by offering trained workers a post-training salary, lower than their marginal product in that firm, but higher than their (current or future) marginal product elsewhere. The employer's contribution to the cost of specific training is the difference during training between the wage paid and the worker's productivity minus the cost of training. The employees' contribution to the costs of general andes they could obtain in jobs that offer no training opportunities.

Hashimoto (1980) and Hashimoto and Yu (1981) have shown that sharing the costs and benefits of a specific human capital investment occurs only when post-investment compensation is prespecified. In his model, the share of specific human capital investment that is paid for by the worker, and, therefore, the rate of wage growth (for any given level of training), is negatively related to the responsiveness of the quit rate to the differential between in-firm and out-of-firm wage rates, positively related to the responsiveness of the dismissal rate to the firm's second period wage. Performance measures that are accurate and acceptable to workers also raise the share of the specific human capital investment that are paid by the worker. Since some of the skills learned in a new job are inevitably specific to the firm, the theories of on-the-job training proposed by Becker (1975) and Hashimoto (1981) imply that productivity net of training costs will rise more rapidly than wage rates during the training period.

The message of most of the other recent theoretical papers on the time pattern of wage rates is quite different. The models that have been developed all seem to imply that the rate of increase of wage rates will equal or exceed the rate of increase of productivity net of training costs. Salop and Salop (1976) and Nickell (1976) have shown that if investments in specific human capital make turnover costly and workers have information not available to firms on how likely they are to quit, some employers will attempt to attract those with low quit probabilities by imposing a hiring fee (through a below market starting wage) and raising the wage level in subsequent periods. The equilibrium wage pattern results in the worker paying all the training costs and receiving all the benefits of investments in specific human capital and in the wage rates rising in step with rises in productivity net of training costs.

Jovanovic (1979) has developed a job-matching theory of turnover which hypothesizes that workers remain in jobs in which their productivity is high and are fired (or quit) from jobs in which their productivity is low. His model predicts that the wage rate is equated to the expected marginal products for all workers and that, as the result of job matching, wage grows as tenure increases.

Lazear (1981) shows that the need to provide incentives for greater effort and the lags in recognizing and rewarding effort result in a wage structure that pays less than marginal product net of training costs early in a worker's tenure at a firm and more than the worker's marginal product toward the end of the worker's tenure. Lazear and Moore (1981) tested this model by comparing the wage profiles of self-employed individuals to the wage profiles of wage and salary employees. Upon finding flatter wage profiles for the self-employed, they concluded that "under some strong assumptions, our conclusion . . . is that most of the slope of the age earnings profile reflects incentive based wealth and not human capital accumulation via on-the-job training" (p. 19). We do not view this test as definitive, however, because flows in and out of self-employment makes it difficult to construct a longitudinal wage profile from cross-sectional data, because self-employed individuals may for some reason invest less in OJT and because Cohn and Kiker (1983) obtain the opposite result using similar methodology.

All of these theories--OJT, self-selection, Lazear's principal agent theory, and Jovanovic's sorting theory--predict that wages will rise with tenure and experience. Consequently, the fact that wages do indeed rise with tenure and experience carries no implication about which theory is best. Truly powerful tests of these competing theories require direct measurement of crucial theoretical constructs that typically have been treated as unobservables in empirical work (e.g., the amount of training received, whether that training is general or specific, and the productivity of the worker). Medoff and Abraham (1981) were the first to collect the data necessary to test the on-the-job training theory of wage profiles with tenure and experience. Using microdata from the personnel records of four large U.S. corporations, Medoff and Abraham found that, within a grade level, there is simultaneously a positive association between wage rate and experience, and there is a negative association between performance rating and experience. They concluded that, "under the assumption that rated performance is a valid indicator of relative productivity, our results imply that a substantial fraction of the return to experience among the groups we are studying is unrelated to productivity" (p. 187). Medoff and Abraham also reviewed a large number of other studies and concluded that the association between seniority in a job and productivity is curvilinear. During the initial very short orientation/training period, there is a positive association. Once this training period is over, however, there tends to be a negative association between tenure and productivity amongst those who occupy a particular job (i.e., have not been promoted to greater responsibility). Almost all the studies were conducted in large corporations, and almost all of the workers included in these studies had many years of tenure at the firm. These findings tend to support the proposition that one and possibly more of the non-OJT explanations of wage growth are substantively important partial explanations of the rise of wage rates with tenure after the initial 1-5 year adjustment/learning period is completed.

Medoff and Abraham's findings do admit to another explanation, however. The data available to Medoff and Abraham provided measures of productivity and wage rates. The theories being tested, however, specify a relationship between productivity net of training costs and compensation. The least tenured workers in a particular employment grade are likely to be those who are receiving rapid promotions. The past and anticipated future job changes of these workers mean they are more likely to receive more intensive training than the older, more tenured workers in that employment grade. This means that even though productivity may be negatively correlated with tenure within an employment grade, productivity net of training costs (production minus the value of the time that others spend training the individual) may be positively correlated with tenure within employment grade.

The other possible hole in the Medoff and Abraham argument is that workers with vested pension rights and many years of tenure may find that the present value of their pension benefits is declining as they postpone retirement.

If this were the case, total real compensation of workers who are not being promoted as they approach retirement might be falling. On this point there is controversy. Lazear's (1981) study of defined benefit pension plans found that the present discounted value of expected pension receipts tends to decline with additional years of tenure once the individual has more than 20 years of tenure and is over age 55. Kotlikoff and Wise (1983), however, do not find declines in pension wealth as retirement is postponed beyond the age of early retirement. The different results are a consequence of different assumptions about interest and inflation rates and a different sample of plans.

The only other study to examine the issue of relative rates of growth of productivity and wage rates is that of Bishop and Stephenson (1982). They found that employers report significant investments in training and significant improvements in the reported productivity of new employees in the first year or two on the job. Furthermore, the amount of training offered on a job has a statistically significant effect on both reported productivity growth and wage growth.[1] These results provide strong support for the proposition that during the first year or two on a job, on-the-job training is a major contributor to a worker's improved productivity and rising wages. These results do not, however, imply that other forces such as self selection or sorting are not contributing to the tendency of wage rates to rise with tenure. In fact, the data support the substantive importance of sorting as a contributor to wage and productivity growth with tenure. Also, they may not be inconsistent with Medoff and Abraham's findings since they relate to only the first year on a job and are for a sample of establishments whose size (the geometric mean is 16 employees) is considerably below that of the firms studied by Medoff and Abraham.

The purpose of this study is to generalize the theory of on-the-job training to include sorting phenomena and to test the predictions of the theory regarding the relative growth rates of wages and productivity net of training costs early in a worker's tenure against the predictions of principal agent theory and of models in which self-selection is based on propensities to quit. A theoretical exposition of a world where two distinct types of skills, general and specific, are produced jointly is presented. The training firm can accurately measure the amount of general training received by its worker, but other firms cannot and rates of time preference of the workers are different from those of their employers. A summary of the major new theoretical findings is as follows:

- The time pattern of compensation will reflect the relative time preference of employers and employees. The slope of the wage-tenure relationship will be negatively related to the degree to which the worker's rate of time preference exceeds the firm's internal rate of return.
- Decisions about provision of specific human capital depend primarily upon the firm's discount rate, not the employee's discount rate.
- When general OJT is perceived accurately by all potential employers, the worker must finance all its costs; it is the worker's discount rate that determines whether the investment is undertaken.
- When employers can measure the amount and quality of general OJT provided to their own workers more accurately than they can measure the training that job applicants have received from other employers, the firm and the worker tend to underinvest in general OJT. The level of investment that results depends on the discount rates, the separation rate, and the proportion of marginal investments in general OJT that are not perceived by other employers.
- Anything that contributes to the specificity of the match has the effect of lowering the wage in the second period below the worker's productivity in the firm. This implies that the starting wage is higher by a compensating amount. Training in skills specific to the firm is one cause of specificity. Additional causes are the adjustment costs of making a transition, the improvement in the average productivity of the remaining workers which results from dismissing the least productive, the average loss that a worker who wants to stay would experience if he or she were forced to leave.

One of the important overall implications of the theory discussed next is that because of the specificity of the match and differential rates of time preference, the rate of wage growth will typically be below the rate of growth of productivity net of training costs.

The format for the remainder of the paper is as follows. "Data" describes the data set used to test the predictions of the theory. Competing theories are then tested in "Results" by constructing estimates of the growth rates of wages and productivity net of training costs and tabulating by the degree of generality of the training. These tests provide support for the theory developed in the next section.

1.2 Theory

Model with Stochastic Quits and Dismissal

The firm's training level and wage profile will be analyzed in a simple two-period model. Training is assumed to produce two types of skills: general skills (g) that are useful at other firms and specific skills (h) that are productive only at the firm providing training. The cost of the training C(g,h) is incurred in the first period and the benefits are received in the second period.

There are two random elements in the model. The first element is the wage offer that competing employers make to the worker at the beginning of the second period; the second element is the worker's productivity during the second period in the firm after the training is completed. It is assumed that wages and productivities in the two periods are as follows:

In the first period at the firm worker's productivity is P and he or she recieves wage w^1; if the worker stays with the firm in the second period his or her productivity is $P + g + h + \ _0$ and the wage rate is w^2; and if the worker leaves the firm the second period wage received from other employment is $w^3(g) + \varepsilon$,

where

P	is the worker's productivity without training,
g	is the increment in productivity due to general training,
h	is the increment in productivity at the firm due to specific training,
ε_0	is the random factor in productivity in this firm which capture the quality of the match at the training firm,
w^1, w^2	are first- and second-period wages at the firm,
$w^3(g)+\varepsilon$	is the wage offer from other employers that depends on the amount of general skill and the random factor that measures the quality of the firm-worker match at the alternative firm.

At the end of the first period, the worker will quit if the alternative wage $(w^3(g)+\varepsilon)$ exceeds the firm's second-period wage (w^2). The worker, not the employer, learns about ε_0 at the end of the first period.

The firm providing the training, but not the worker, knows the worker's productivity in this firm ($P+g+h+\varepsilon_0$) by the end of the first period.[2] If the worker's productivity is less than the second period wage, the firm will dismiss the worker. The random factor ε_0 is a measure of the quality of the firm-worker match at the current firm. We assume the expected values of ε and ε_0 are zero.

There are four possible combinations of worker-firm decisions at the end of first period, as shown in table 1-1.

TABLE 1-1
Worker-Firm Decisions

Worker	Firm	Result
Stay	Keep	Retention
Stay	Dismiss	Separation
Quit	Keep	Separation
Quit	Dismiss	Separation

At the beginning of the first period, neither the worker nor the firm know the worker's exact productivity in this firm and in other firms. The firm offers a wage package (w^1,w^2) that is based on the prior knowledge of the worker's productivity and the nature of uncertainties involved (i.e., p.d.f. of ε_0 and ε). In the first period, the firm invests in the training of the worker, taking into account the possible loss due to separation in the following period. Training investment takes two forms: investment in firm-specific skills and general skills. General training increases the wage that the worker can obtain in alternative employment as well as his or her productivity in this firm, whereas specific training does not affect his productivity outside the firm. Workers accept the job offer from this firm if the wage package and training plan are generous enough to attract workers in a competitive labor market. In their decision, workers take into account the possible gains or losses from a voluntary or involuntary separation. It is assumed that the worker and the firm have the same prior distributions on the uncertainties surrounding the worker's productivity in this firm and worker's income opportunity outside the firm in the second period. Further, it is assumed that both firm and worker are risk neutral. At the end of the first period, the worker learns what wage he or she can get in the second period at other firms. This real wage is affected by the amount of general training perceived by other employers and the cost involved in making the transition. If the wage offer from the other firm (net of transition cost) is higher than the firm's wage (w^2), the worker will quit. By the end of the first period, the firm knows the worker's productivity in the second period.

The firm's objective is to maximize the discounted sum of profit from two periods by choosing wage rates in two periods (w^1 and w^2), and an amount of general training, (g), and specific training, (h), subject to the constraint that the wage offer and the amount of training are generous enough to attract new hires in a competitive labor market. The firm's expected profit maximization problem when ε and ε_0 are independent is written as--

$$(1) \quad \underset{g,\ h,\ w^1,\ w^2}{\text{Max}}\ P - C(g,h) - w^1 + D_a[Pr(S)\ Pr(K)(P+g+h+E(\varepsilon_0|K))-w^2]$$

Subject to the constraint

$$(2) \quad R \leq w^1 + D_b[Pr(S)Pr(K)w^2 + (1-Pr(K))w^3 + (1-Pr(S))Pr(K)(w^3+E(\varepsilon|Q))]$$

where

$E(\varepsilon_0|K)$ is the expected value of ε_0 given that the firm wishes to keep the worker,

$E(\varepsilon|Q)$ is the conditional expectation of ε given that the worker quits the firm,

D_a and D_b are the discount factor of the firm and worker, respectively

$Pr(S)$ is the prior probability the worker is willing to stay with the firm,

$Pr(K)$ is the prior probability the firm is willing to keep the worker,

R is the level of expected utility the worker can attain in the competitive labor market.

The probability of a worker wishing to stay in the firm, $Pr(S)$, is

$$(3) \quad Pr(S) = Pr(w^3(g) + \varepsilon \leq w^2) = Pr(\varepsilon \leq w^2 - w^3(g))$$
$$= \Phi(w^2 - w^3(g))$$

where

Φ is the cumulative density function (c.d.f.) of ε.

Also, Pr(K) is written as--

(4) $\Pr(K) = \Pr(P+g+h+\varepsilon_0 \geq w^2)$
$= \Pr(\varepsilon_0 \geq w^2-P-g-h)$
$= 1 - \Phi_0(w^2-P-g-h)$

where

Φ_0 is the c.d.f. of ε_0.

Denoting the probability density function (p.d.f.) of Φ and Φ_0 by ϕ and ϕ_0, the first-order condition for the second period wage is written as--

(5) $0 = D_a[\phi \cdot \Pr(K)D_k - \Pr(S)\Pr(K)] + D_b[\Pr(S)\Pr(K) - \phi_0 G_k]$

where

D_k and G_k are defined as
$D_k = P+g+h+E(\varepsilon_0|K)-w^2 > 0,$
$G_k = \Pr(S)w^2+(1-\Pr(S))(w^3+E(\varepsilon|Q))-w^3 > 0.$

D_k is the firm's expected profit on workers who want to stay and it wants to keep. Alternatively, it may be intrepreted as the quasi-rent the firm receives in the second period on the workers they keep. G_k is the gain the worker receives from not being dismissed. G_k can be interpreted as the expected wage if kept, $\Pr(S)w^2+(1-\Pr(S))(w^3+E(\varepsilon|Q))$, minus the expected wage if dismissed, w^3, or alternatively the quasi-rent received by workers who are kept in the second period.

The first-order conditions for general and specific training (g and h) are given by (6) and (7).

(6) $C_g = D_a[\Pr(S)\Pr(K) - \phi w_g^3 \Pr(K)D_k] + D_b[(1-\Pr(K)\Pr(S))w_g^3 + \phi_0 G_k]$

where

$C_g = \partial C/\partial g$, $w_g^3 = \partial w^3/\partial g$,

(7) $C_h = D_a \cdot \Pr(S)\Pr(K) + D_b \phi_0 G_k$

where

$C_h = \partial c/\partial h$.

Also the optimal wage in the first period, w^1, is determined so that the constraint (3) is binding.

(8) $R = w^1 + D_b[Pr(S)Pr(K)w^2 + (1-Pr(K))w^3 + (1-Pr(S)Pr(K)(w^3+E(\varepsilon|Q))]$

The first order conditions--(5), (6), (7), and (8)--characterize the optimal wage and training package the firm will offer. In what follows, the economic implications of these conditions are examined.

Choosing the Wage Structure

The understanding of what determines w^2 will be aided by specifying the income opportunity outside the firm, $w^3(g) + \varepsilon$, in more detail. We write $w^3(g)$ in the following form:

(9) $w^3(g) = P + \hat{g} - T$

where P is the productivity of a worker who does not receive general training in the first period, $\hat{g}$ is the increment of the wage offer due to general training, and T is the transition cost. Employers use the interview and the reputation of the previous employer to predict the true value of the general training. The estimate by other employers of the productivity gain due to the original firm's general training is $\hat{g}$.

Other potential employers cannot observe the exact amount of human capital that is produced by the training.[3] The signal that provides information on the level of training contains a good deal of noise. Denoting the signal other employers receive by $\tilde{g}$, the following relation is assumed:

$\tilde{g} = g + v$, v is a noise independent of g

Given the signal, $\tilde{g}$, other firms predict the true level of general skill. The predicted value is denoted by $\hat{g}$. When the distribution of ε and ε_0 is normal the conditional expectation of general skill given prior information of g and signal $\tilde{g}$ is given by the following formula:

$\hat{g} = E(g|J) + b(\tilde{g}-E(g|J)) = E(g|J) + b[g-E(g|J)] + bv$

where $E(g|J)$ is the other firm's prior expectation of general human capital of the particular class of job seekers, given information set J. J represents the worker's characteristics visible to the prospective employer, such as, occupation, industry, and firm size of previous job and background characteristics of the individual, and b is given by--

$$b = \frac{var(g|J)}{var(g|J)+var(v)} < 1$$

where var(g|J) is the conditional variance of g given J. (See Leamer [1978], pp. 51-55.) This implies that a unit increase of general skill results in less than proportional increases in other firms' wage offers.

Substituting (9) into the first order condition for w^2, and after rearranging terms, the optimum wage rate in the second period is written as follows:

$$(10) \quad w^2 = [P+h+g+E(\varepsilon_0|K)] - \frac{\theta}{1+\theta} [T+E(\varepsilon_0|K) + (h+g-g) - E(\varepsilon|S)] - \frac{(D_a-D_b)}{D_a} \frac{Pr(S)}{(1+\theta)\phi}$$

where

$$\theta = \frac{D_b}{D_a} \cdot \frac{\phi_0}{\phi} \frac{Pr(S)}{Pr(K)}$$

and $E(\varepsilon|S)$ is the conditional expectation of ε given the worker wishes to stay in the firm.

Equation (10) implies that the expected profit from the worker staying with the firm is positive. Since in the long-run equilibrium, competition among firms brings the expected profit of the firm to zero, the wage rate in the first period must be higher than the worker's productivity net of training cost by a compensating amount. Thus our model predicts that in the early stage of employment, productivity net of training cost grows faster than wage rate. The firm's net profit is negative in the investment period, but the loss is compensated for in the second period when the firm receives the return from human capital investment.

The wage offer in the second period is the expected productivity of the worker, $P+g+h+E(\varepsilon_0|K)$, less the second and third terms in (10). The second term indicates that given the value of θ, the factors that reduce the firm's second-period wage offer (and also raise the firm's first-period wage offer). are--

- transition cost, (T);
- difference between a worker's true general human capital (g) and other employer's perception of his general human capital $\hat{g}$. This could be positive or negative depending upon whether the firm provides more or less general training than is average for that occupation and industry; and
- average unattractiveness of alternative employment to the worker who wants to stay, $(-E(\varepsilon|S))$.

The expression in brackets is the difference (for those workers who are kept and want to stay) between the worker's productivity in the firm, $P+g+h+E(\varepsilon_0|K)$, and the worker's income on his or her next best alternative, $P+\hat{g}-T+E(\varepsilon|S)$.

Anything that raises productivity in the firm but does not raise it outside the firm will raise the second period wage at the firm. The wage increase is smaller than the rise in productivity so the firm's profit on the worker in the second period goes up. The two factors that will produce this effect are--

- specific human capital (h), and
- expected gain from having the option of dismissing less productive workers $(E(\varepsilon_0|K))$.

Also, other things being equal, the second period wage offer declines if $\theta/1+\theta$ is large. A factor that makes $\theta/(1+\theta)$ large is--

- the second period wage has a larger proportionate impact on the probability the employer will keep the trained worker than it has on the probability the worker will want to stay.

The third term of (10) reflects the fact that the model is characterizing wage and training contracts at firms that face an infinitely elastic supply of new hires but a less than infinitely elastic supply of trained labor. New hires take second period wages into account when evaluating the firm's job offer. Consequently, the decline in the elasticity of labor supply with the worker's tenure influences the wage structure only when the firm and its workers have different rates of time preference. Workers typically have higher rates of time preference (i.e., lower discount factors) than firms. Subsidized student loans are not available for financing investments in on-the-job training. Without collateral, banks will not lend money for this purpose. Even with collateral, the loan will be at an interest rate that exceeds the interest rates charged businesses by a considerable amount. In addition, workers are more likely than firms to face a higher marginal tax rate in the second period than in the first period. These two factors result in firms being more willing than workers to trade off future earnings for present earnings. The compensation packages that result reflect the worker's preference for compensation now rather than later. Thus, the third term of (10) implies that the firm's second period wage offer will be reduced and the first- period wage increased to the extent that--

- the firm's discount factor is larger than the worker's discount factor, $D_a - D_b > 0$, and
- the proportionate response of the proportion staying ($\phi/Pr(S)$) to the firm's second period wage is small (e.g., the labor supply elasticites of trained workers are low).

Choosing the Level of Training

The f.o.c. for specific capital, (7), says that the marginal cost of investment in specific capital is equated to the marginal discounted revenue to the firm--the discount factor times the retention rate times $1.00 ($D_a Pr(S) Pr(K)$) plus the discounted marginal benefit to the worker of the specific training. Benefit of specific training to the worker is captured by the second term of (7). The increased productivity makes the firm less likely to dismiss the worker. This effect is captured by ϕ_o. In (7), ϕ_o is multiplied by G_k--the benefit the worker receives from not being dismissed.

The first-order condition for general training, (6), characterizes the optimal amount of general training. The marginal cost of general training is equated to the discounted marginal revenue to the firm plus the discounted marginal benefit to the worker. The marginal revenue to the firm from general training has two elements. The first element is the marginal product of a dollar of expenditure on general training for the workers who are going to stay with the firm ($Pr(S)Pr(K)$). The second element measures the loss the firm is likely to experience because, with given w^2, quit rates will rise. The higher level of general skill implies better alternative income opportunities for the worker. For a given second-period wage, quits will rise by ϕw_g^3. Per quit, the loss the firm experiences is $Pr(K)D_k$--the probability the firm wants to keep the worker times the quasi-rent received by the firm from those workers it keeps.

The marginal benefit of general training to the worker also has two elements. The first element is that, if the worker is leaving the firm (voluntarily or involuntarily), general training increases the wage offer in other employment. The second element reflects the fact that the increased productivity makes the firm less likely to dismiss the worker. This benefits the worker, and the amount of the benefit is G_k. The worker benefit of reduced risks of dismissal roughly offsets the loss the employer experiences from the quits that are induced by the rise in other firms' wage offers.[4]

If other firms fully perceive the quality of training provided by the firm (b=1), the condition reduces to setting the marginal cost of training (C_g) equal to D_b, the worker's discount factor. If other firms cannot perceive differentials in training quality (b = 0), the condition becomes identical to that for specific human capital.

The inability of other firms to perceive all of the firm-to-firm variations in the amount of general human capital has the effect of dividing the marginal returns to general human capital into two parts. The share of the total return that the worker is assured of getting, whether or not he or she stays at the firm (b), is discounted by the worker's rate of time preference. The share that is perceived only by the firm that provides the training (1-b) is depreciated by the retention rate and discounted by the employer's internal rate of return. Equation (11) implies that investment in general OJT increases with the firm's and the worker's discount factor (D_a and D_b) and the retention rate and decreases with its marginal cost. Because turnover rates of new hires are rather high, we expect that $D_a Pr(S)Pr(K) + D_b \phi_o G_k < D_b$.[5] If so, an increase in the quality of the signals available to other firms will increase investment in general OJT.

1.3 Data

An employer survey sponsored by the National Institute of Education and the National Center for Research in Vocational Education conducted between February and June 1982 provides the basis for analyzing the size and character of on-the-job training and testing the theory developed in the previous section. The survey design specified a strategy of oversampling firms with a relatively high proportion of low wage workers.

The respondents were the owner/manager of the establishment, controllers, wage and salary administrators, and line supervisors who observed the worker's job performance. Each employer surveyed was asked about the training provided to the last employee hired prior to August 1981, current and starting hourly wage rates and an average rate paid to workers with 2 years of experience, and the performance of the new hire during the first 2-year period. The 2,264 employers who provided answers to a series of questions concerning the last person hired make up the sample of employers whose hiring activity was to be examined.[6]

Data were obtained on the amount of time that is devoted to training new employees during their first 3 months. Separate questions were asked about training hours spent in formal training, informal training by management, informal training by co-workers, and watching others do the job.[7] For the sample of firms and jobs, the means for the typical worker were as follows:

- Watching others do the job--47.3 hours
- Formal training programs--10.7 hours
- Informal training by management--51.0 hours
- Informal training by co-workers--24.2 hours

A training time index was constructed that valued and then combined the time invested in training activities during the first 3 months on the job. The management staff members who provided formal and informal training were assumed to be paid 1.5 times the wage of a co-worker and the trainee's time was valued as equal to 0.8 hour of co-worker training time. When supervisors and co-workers are giving informal training to a new employee, the trainee is almost invariably involved directly in a production activity. Employers report that for informal training, the trainees are typically as productive while being trained as they are when working alone. Consequently, informal training is assumed to involve only the investment of the trainer's time. The training time index is equal to 0.8 times the hours spent watching others do the job plus 1.8 times the hours in formal[8] training plus 1.5 times the hours in training by management plus hours in training by co-workers.[9] The arithmetic mean of this index is 124 hours, implying that the value of the time invested in training a typical new employee in the first 3 months is about 23 percent of the output that a co-worker would produce in 3 months.

The survey asked the employer (or in larger firms the immediate supervisor) to report on the productivity of the typical individual hired in the job after 2 weeks, 12 weeks, and at the end of 2 years at the firm.[10] The mean values of these indexes of reported productivity were as follows:

- First 2 weeks--49.0
- Next 10 weeks--64.6
- After 2 years--81.4

In most of the work to follow, it is assumed that these productivity indexes are proportional transformations of true productivity plus a random error.[11] This makes it possible to combine the estimates of time investments in training with these productivity estimates to produce estimates of productivity net of training costs of each new hire during the first 3 months of employment. The assumption that these productivity indexes are a proportional transformation of true productivity plus a random error is, of course, arbitrary. Sensitivity to the main findings concerning this assumption will be tested by presenting estimates of total training costs that are based on 3 alternative assumptions: proportionate differences in productivity are in fact 150 percent of those reported, 50 percent of those reported and nonexistent. The general formula for these calculations is--

$$(12) \quad NP = \frac{RP \cdot TP}{520} - \frac{CT + 1.5*MTI + MTF}{520}$$

where

NP = productivity net of training cost of typical new hire

RP = relative productivity of new hire to productivity of typical worker with two years' tenure

$$= \frac{.167\ PROD2_i + .833\ PROD312_i}{PRODTYP}$$

TP = time attempting to produce. The conservative calculation of training costs assumes TP = 520. Calculations using liberal assumptions assumes TP = 520 - TW - TF.

PROD2 = reported productivity of typical new hire during the first 2 weeks

PROD312 = reported productivity of typical hire during the next 10 weeks

PRODTYP = reported productivity of typical worker in same job with 2 years' tenure

TW = time watching others over the first 3 months

TF = time spent in formal training over the first 3 months

CT = co-worker time spent training new hire informally over the first 3 months

MTI,(MTF) = management time spent training new hires informally (formally) over the first 3 months.

1.4 Results

The theory developed in section 2 predicts that even when training is entirely general, wage rates will rise more slowly than productivity net of training costs. This outcome is predicted whenever workers have higher rates of time preference than firms, or whenever there are other sources of specificity besides specific training such as costs of transfer or the impacts of selective retention. This prediction contrasts with the predictions of Becker's theory of general human capital, Lazear's agency model, Jovanovic's sorting model, and Salop and Salop's self-selection model. These models all predict that when training is general, wage rates will rise at a rate that is at or above the rate of growth of productivity net of training cost. Data on training, reported productivity, and wage rates during the first 2 years of tenure on a job from a sample of 1,493 recently hired workers will be used to test these competing theories. In order to minimize problems of recall and of adjusting actual starting wage rates for inflation since the date of hire, the sample was limited to jobs of new employees who were hired after July 1, 1980 (e.g., less than 24 months prior to the interview).

Employers were asked "How many of the skills learned by new employees in this job are useful outside of this company?" Fifty-nine percent responded "almost all," 13 percent responded "most," and only 7.5 percent answered "almost none." This question provides us with an independent direct measure of the generality of the training provided by a firm. It allows us to test our hypotheses about relative rates of growth of wage rates and training in a sample of jobs that require highly general skills. The employers were next asked how many other local firms made use of the general skills that were developed in their training. This question allows a further refinement of our classification of jobs. The jobs that offer the most general skill training are defined to be those reported to have "almost all" of their skills useful at other firms and 16 or more other firms in the local labor market that in fact use these skills. Data for these jobs are presented in the first column of table 1.2. The second column presents data for the jobs where almost all of the training was useful in other firms, but here the number of such firms in the locality was small enough (below 16) to suggest that employers might have some monopsony power. The groupings for the other three columns are based only on the generality of the skills taught without regard to the size of the local market for these skills.

The first two rows of the table present mean ratios of starting to current or second year wage rates. Since the starting wage is a wage paid about a year previous to the interview, after adjusting for inflation, only 8 or 9 percent of the 16 percent increase reflects wage progression with tenure. Wage increases are similar in all of the jobs with some generality in their training. The wage increase in jobs offering almost no training in skills that are useful at other firms is much smaller and can probably be fully accounted for by inflation. The lack of any wage progression with tenure in these jobs suggests that employers pay for and receive almost all the benefits of specific training.

The second panel of table 1.2 reports answers to questions about the number of hours devoted to four distinct training activities. Training for jobs with the most general training and many local competitors involves an average of 49 hours watching others do the job, 9.6 hours in formal training, 52 hours in informal training by management, and 25.6 hours in informal training by co-workers in the first 3 months. The time devoted to training has a value equivalent to 147 hours of an already trained co-worker's time. As long as some of the skills taught are general, the required training time seems to be unrelated to the reported degree of generality. However, jobs reported to teach almost no skills useful in other firms (i.e., have training that is completely specific to the firm) require less training--118 rather than 147 hours in the first 3 months.

The final row in the panel reports the geometric mean of the answers to the question "How many weeks does it take for a new employee hired for this position to become fully trained and qualified if he or she has no previous experience in this job, but has the necessary school-provided training." Jobs for which only some or almost none of the skills are useful in other firms take an average of 5 or 6 weeks to learn.

TABLE 1.2

TRAINING, WAGES, AND PRODUCTIVITY OF TYPICAL NEW EMPLOYEES BY GENERALITY OF SKILLS TAUGHT

	Number of Skills Useful Outside This Company				
	Almost All				
Wage, Training, and Productivity	GT 16 other firms	LT 16 other firms	Most	Some	Almost None
Wage Rates					
Ratio starting/2 years	.86	.85	.83	.83	.93
Ratio starting/current	.88	.89	.88	.88	.90
Hours Spent in Specific Training Activities in First 3 Months					
Watching others do the job	49.0	50.9	48.1	46.3	27.6
Formal training programs	9.6	9.3	6.3	10.0	7.9
Informal training by management	51.9	55.8	58.1	53.8	41.0
Informal training by co-workers	25.6	26.9	25.2	22.7	27.1
Investment in training time	147.1	156.5	148.9	147.3	118.0
Weeks to become fully trained	7.8	8.3	7.9	5.8	4.8
Reported Productivity					
Ratio first 2 weeks to 2 years	.60	.59	.58	.60	.64
Ratio next 10 weeks to 2 years	.79	.79	.78	.81	.83
Ratio of Productivity Net of Training Costs in First 3 Months to Productivity of a Worker with 2 Years of Tenure					
Liberal assumptions	.46	.44	.44	.47	.55
RP (true) = 0	.72	.70	.71	.72	.77
Conservative assumptions					
RP (true) = RP (meas.)	.55	.53	.52	.56	.62
RP (true) = .5 RP (meas.)	.67	.66	.66	.68	.72
RP (true) = 1.5 RP (meas.)	.42	.40	.38	.44	.52
Number of cases	557	326	192	304	114

NOTE: Sample is limited to jobs for someone hired less than 2 years earlier and for which all the necessary questions on wage rates, training time, and productivity were answered.

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This training seems to have the hoped for results of increasing the productivity of the new employees. The third panel of the table presents ratios those with 2 years of tenure. During the first 2 weeks, the typical new employee at firms offering general training is reported to be only 59-60 percent as productive as the typical worker with 2 years of tenure and experience. During the next 10 weeks at the firm, the typical new employee's productivity is reported to be 79 percent that of a worker with 2 years of tenure. As one would expect, the reported productivity of new employees increases more rapidly in the first month or so than it does later. The increase in the worker's reported productivity seems to be considerably greater than the 8 or 9 percent increase in the worker's wage after accounting for the inflation of scale wage rates.[12] This occurs despite the fact that the training is reported to be almost entirely general and there are many local firms that use the skills in question.

The bottom panel of table 1.2 presents estimates of the ratio of productivity net of training costs in the first 3 months of employment to the productivity of a typical worker with 2 years of tenure in the firm. The sensitivity of these estimates to the assumptions about the scaling of the productivity index can be examined by comparing the rows. Our preferred estimates, those calculated using conservative assumptions, are in the third row of the panel. The conservative estimate is obtained by subtracting the value of time expended by others--management and co-workers--from the estimate of the new worker's productivity.[13] The liberal estimate of productivity net of training costs assumes that the trainee produces no current output when receiving formal training or watching others do the work, and, therefore, subtracts the value of the trainee's time devoted to formal training or watching others do the work from the previously described conservative estimate of productivity net of training costs.[14] The estimates are presented in the first row of the bottom panel. The second row of the panel presents estimates based on the extreme assumption that productivity per hour engaged in a nontraining activity does not increase during the first 2 years on the job at all. Time fully devoted to training (i.e., the training time investment reported in row 5 of the second panel divided by 520) is subtracted from 1 to produce the estimate of the productivity net of training cost ratio.

The fourth row of the panel presents estimates based on the assumption that the reports of productivity differences supplied by our respondents exaggerate true proportionate differences in productivity by a factor of two. The fifth row of the panel presents estimates that are based on the assumption that proportionate differences in true productivity between new and experienced workers are 50 percent greater than those reported. These two rows aggregate time estimates and productivity differences using the conservative assumption that the lower productivity reported for new workers reflects in part the portion of their time that is devoted to formal training and watching others do the work.

The 1982 National Employer Survey found that the time others spend training a new employee during the first 3 months has a value equal to 19 percent of the productivity of a worker with 2 years of tenure. The survey also found that the average new employee spends 11 percent of his or her time in the first 3 months either watching others do the job or in a formal training program. The survey did not, however, ask questions about the time devoted to training after the first 3 months on the job. Consequently, the ratios reported in the bottom panel compare reported productivity net of training cost in the first 3 months to reported productivity at the end of the second year. A calculation of the ratio of productivity net of training costs at these two points in time requires that the value of time devoted to training be subtracted from the denominator as well as the numerator. A rough estimate of the correction needed can be obtained by consulting a 1983 National survey of employers that did ask about time devoted to training in the second year of employment (Hollenbeck and Smith 1984). It found that in the second year on the job the proportion of time devoted to a full-time training activity was about one half of the corresponding proportion of the first month.[15] This means that a rough estimate of the rate of growth of productivity net of training costs can be obtained by dividing the numbers in the bottom panel of table 1.2 by 0.905 when conservative aggregation assumptions are being used and by 0.85 when liberal aggregation assumptions are used.

Tests of our central hypothesis--that productivity net of training costs rise more rapidly than compensation during the first 2 years in a job even when the training is reported to be completely general--are presented in table 1.3. This involves testing the null hypothesis, H_0, which states that the ratio of productivity net of training cost in the first 3 months to productivity net of training cost at the end of 2 years, NP_s/NP_{2yr}, is equal to or greater than the ratio of hourly compensation at these 2 points in time, W_s/W_{2yr}. The hypothesis is tested under three different maintained assumptions about the validity of our measures of relative productivity, and for two alternative assumptions about how to aggregate reports of trainee productivity and the time others devote to the new employee's training. The adjustments necessary to calculate estimates of the ratio of starting 2 year productivity net of training costs were described in the previous paragraph. The estimate of the relevant wage ratio, W_s/W_{2yr}, was obtained by adding 0.08, the rate of growth of adjusted hourly wages from the second quarter of 1981 to the second quarter of 1982, to the wage ratio presented in the first row and column of table 1.2.

The first 2 columns of table 1.3 report hypothesis tests that are conditional on the maintained assumption that the rate of growth of compensation and wage rates are equal. The next 2 columns of the table are based on a maintained assumption that compensation typically rises 5 percent faster than wage rates during the first 2 years on a job.[16] The 2 columns on the far right hand side of the table are based on a maintained assumption that compensation typically rises 10 percent faster than wage rates during the first 2 years on a job.

The t-statistics reported in the table imply a decisive rejection of the hypothesis that the rates of compensation for jobs reported to offer completely general training rise at a rate that is equal to or greater than the rise in productivity net of training costs. The finding that in the first 2 years of tenure compensation rises less rapidly than productivity net of training costs is quite robust. If compensation rises no more than 5 percent faster than wage rates, the hypothesis is rejected even when we make the truly extreme assumption that, although respondents report to the contrary, there is no increase in worker productivity in the first 2 years on a job. If compensation increases 10 percent faster than wage rates, the hypothesis is rejected

TABLE 1.3

T-TESTS OF THE HYPOTHESIS THAT PRODUCTIVITY NET OF TRAINING COSTS RISES FASTER THAN WAGE RATES IN JOBS WITH GENERAL TRAINING AND MANY COMPETITORS

	$H_1: \frac{NP_s}{NP_{2yr}} - \frac{W_s}{W_{2yr}} - .08 < 0$		$H_1: \frac{NP_s}{NP_{2yr}} - \frac{W_s}{W_{2yr}} - .03 < 0$		$H_1: \frac{NP_s}{NP_{2yr}} - \frac{W_s}{W_{2yr}} + .02 < 0$	
Definition of NP	All Hires	Recent Hires	All Hires	Recent Hires	All Hires	Recent Hires
Liberal Assumptions	18.8	18.4	16.0	15.2	13.2	12.0
Conservative Assumptions	18.4	17.6	15.2	14.6	12.0	11.6
RP(true) = .5 RP (measured)	12.1	12.2	8.2	8.6	4.3	5.0
RP(true) = 0	7.4	7.9	1.9	2.5	NS	NS
Number of Cases	676	557	676	557	676	557

NOTE: The hypothesis tests assume NP_s/NP_{2yr} and W_s/W_{2yr} are independent. It is as more likely their covariance is positive, t-statistics would be even higher. The column titled Recent Hires uses statistics reported in table 1.2 and is based on jobs for which there was a hire less than 2 years ago. Ws is the nominal starting wage of people who began work an average of a year before the interview, so 0.08 was added to W_s/W_{2yr} in the first 2 columns. The 2 right-hand columns assume that 2 years of tenure raise fringe benefits enough to increase the rate of growth of compensation by 10 percent. This implies that (0.08-0.10) should be added to the W_s/W_{2yr} when testing the hypothesis.

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even when it is assumed that the true increase in relative productivity with tenure is only half of what was reported by our respondents.

These results can be viewed as evidence that in the first year or so on a job the forces tending to cause wages to grow more slowly than productivity net of training costs are stronger than those having the opposite effect. This is true even when the training is reported to be general.[16] The forces that tend to cause starting wage rates to be higher than productivity net of training costs and therefore wage growth to be slower than the growth of productivity net of training costs are--workers having higher rates of time preference than firms and sources of job-worker match specificity such as sorting, costs of transfer, specific training and extra general training that is not recognized by others in the labor market. The forces that work in the opposite direction are the need to design wage structures to attract those with low quit probabilities (Salop and Salop 1976), and to reduce shirking (Lazear 1981). The great deal of specificity to job-worker matches that is impled by these results means that turnover is extremely costly for the worker, the firm, and society.

APPENDIX A

Computational Notes

The firm's expected profit maximization problem is written as—

(A.1) $$\underset{g,\ h,\ w^1,\ w^2}{\text{Max}}\ P-C(g,h)-w^1+D_a\{Pr(S)Pr(K)(P+g+h+E(\varepsilon_o|K)-w^2)\}$$

subject to

(A.2) $$R \leq w^1+D_b\{Pr(S)Pr(K)w^2+(1-Pr(K))w^3+(1-Pr(S))Pr(K)(w^3+E(\varepsilon|Q))\}$$

Denoting the Lagrangean function and the multiplier by L and λ, the first order conditions for g, h, w^1, w^2 are as follows:

(A.3) $$-Cg+D_a\{\frac{\partial(Pr(S)Pr(K))}{\partial g}(P+g+h+E(\varepsilon_o|K)-w^2)+Pr(S)Pr(K)(1+\frac{\partial E(\varepsilon_o|K)}{\partial g})$$

$$+\lambda D_b\frac{\partial(Pr(S)Pr(K))}{\partial g}w^2+(1-Pr(K))w_g^3-\frac{\partial Pr(K)}{\partial g}w^3$$

$$+(\frac{\partial Pr(K)}{\partial g}-\frac{\partial(Pr(S)Pr(K))}{\partial g})(w^3+E(\varepsilon|Q))$$

$$+(1-Pr(S)Pr(K))\{w_g^3+\frac{\partial E(\varepsilon|Q)}{\partial g}\}]=0$$

(A.4) $$-C_h+D_a\{\frac{\partial(Pr(S)Pr(K))}{\partial h}(P+g+h+E(\varepsilon_o|K)-w^2)+Pr(S)Pr(K)(\frac{\partial E(\varepsilon_o|K)}{\partial h}+1)\}$$

$$+\lambda D_b\{\frac{\partial(Pr(S)Pr(K))}{\partial h}w^2-\frac{\partial Pr(K)}{\partial h}w^3+(1-Pr(S))\frac{\partial Pr(K)}{\partial h}(w^3+E(\varepsilon|Q))\}$$

$$=0$$

(A.5) $$-1+\lambda=0$$

(A.6) $$D_a\{\frac{\partial(Pr(S)Pr(K))}{\partial w^2}(P+g+h+E(\varepsilon_o|K)-w^2)+Pr(S)Pr(K)(\frac{\partial E(\varepsilon_o|K)}{\partial w^2}-1)\}$$

$$+\lambda D_b\{\frac{\partial(Pr(S)Pr(K))}{\partial w^2}(w^2+Pr(S)Pr(K)-\frac{\partial Pr(K)}{\partial w^2}w^3$$

$$-\frac{\partial(Pr(S)Pr(K))}{\partial w^2}(w^3+E(\varepsilon|Q))+(1-Pr(S)Pr(K))\frac{\partial E(\varepsilon|Q)}{\partial w^2}\}=0$$

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The conditional expectations of the random factors are given by--

$$E(\varepsilon_o|K) = \int_{w^2-P-g-h}^{\infty} \tau\phi_o(\tau)d\tau \;/\; Pr(K)$$

$$E(\varepsilon|Q) = \int_{-\infty}^{w^2-w^3(g)} \tau\phi(\tau)d\tau \;/\; Pr(Q).$$

Then the partial derivatives with respect to g, h, w^2 are*>

$$\frac{\partial Pr(S)}{\partial g} = -\phi w_g^3, \qquad \frac{\partial Pr(S)}{\partial h} = 0, \qquad \frac{\partial Pr(S)}{\partial w^2} = \phi,$$

$$\frac{\partial Pr(K)}{\partial g} = \phi_o$$

$$\frac{\partial Pr(K)}{\partial h} = \phi_o$$

$$\frac{\partial Pr(K)}{\partial w^2} = -\phi_o$$

$$\frac{\partial E(\varepsilon_o|K)}{\partial g} = -\phi_o \cdot D_K/Pr(K)$$

$$\frac{\partial E(\varepsilon_o|K)}{\partial h} = -\phi_o \cdot D_K/Pr(K)$$

$$\frac{\partial E(\varepsilon_o|K)}{\partial w^2} = \phi_o D_K/Pr(K)$$

where $D_K = P+g+h+E(\varepsilon_o|K)-w^2$

$$\frac{\partial E(\varepsilon|Q)}{\partial g} = \phi w_g^3\ D_Q/Pr(Q)$$

$$\frac{\partial E(\varepsilon|Q)}{\partial h} = 0$$

$$\frac{\partial E(\varepsilon|Q)}{\partial w^2} = -\phi D_Q/Pr(Q)$$

where $D_Q = w^2-w^3-E(\varepsilon|Q)$.

---

*> ϕ_o is evaluated at $w^2-P-g-h$,

ϕ is evaluated at w^2-w^3.

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The next expressions are important to what follows:

$$\alpha_g \equiv \frac{\partial(\Pr(S)\Pr(K))}{\partial g} = \phi \cdot w_g^3 \Pr(K) + \phi_o \cdot \Pr(S),$$

$$\alpha_w \equiv \frac{\partial(\Pr(S)\Pr(K))}{\partial w^2} = \phi \cdot \Pr(K) - \phi_o \cdot \Pr(S),$$

$$\alpha_h = \frac{\partial(\Pr(S)\Pr(K))}{\partial h} = \phi_o \Pr(S).$$

Substitution of the partial derivatives into (A.3), (A.4), and (A.6) yields the f.o.c.'s for g, h, and w^2.

From the f.o.c. for g, (A.3)

$$\begin{aligned} C_g = {} & D_a[\alpha_g D_K + \Pr(S)\Pr(K)(1 - \phi_o D_K/\Pr(K))] \\ & + D_b[(\alpha_g w^2 + (1-\Pr(K))w_g^3 - \phi_o w^3 + (\phi_o - \alpha_g)(w^3+E(\varepsilon|Q)) \\ & + (1-\Pr(S)\Pr(K))\{w_g^3 - \phi w_g^3 D_Q/(1-\Pr(S))\}]. \end{aligned}$$

After rearranging terms, we obtain the equation (6).

$$\begin{aligned} \text{(6)} \quad C_g = {} & D_a[\Pr(S)\Pr(K) - \phi w_g^3 \Pr(K) D_K] \\ & + D_b[(1-\Pr(S)\Pr(K))w_g^3 + \phi_o G_K] \end{aligned}$$

where $G_K = \Pr(S) D_Q + E(\varepsilon|Q))$.

From (A.4)

$$\begin{aligned} C_h = {} & D_a[\alpha_h \cdot D_K - \Pr(S)\phi_o \cdot D_K + \Pr(S)\Pr(K)] \\ & + D_b[\alpha_h \cdot w^2 - \phi_o w^3 + (1-\Pr(S))\ \phi_o \cdot (w^3+E(\varepsilon|Q)). \end{aligned}$$

This yields the f.o.c. for h, (7).

$$\text{(7)} \quad C_h = D_a \Pr(S)\Pr(K) + D_b \phi_o G_K.$$

From (A.6)

$$\begin{aligned} 0 = {} & D_a[\alpha_w D_K + \Pr(S)\Pr(K)(D_K \phi_o/\Pr(K) - 1)] \\ & + D_b[\alpha_w w^2 + \Pr(S)\Pr(K) + \phi_o w^3 - \alpha_w(w^3+E(\varepsilon|Q)) \\ & - (1-\Pr(S)\Pr(K))(\phi D_Q/\Pr(Q))]. \end{aligned}$$

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After rearranging terms, we get (5):

$$(5)\quad 0 = D_a[-\phi \cdot Pr(K)\, D_K + Pr(S)Pr(K)] + D_b[Pr(S)Pr(K) - \phi_o\, G_K].$$

From (5),

$$D_K = P+g+h+E(\varepsilon_o|K) - w^2 = \frac{D_a-D_b}{D_a}\,\frac{Pr(S)}{\phi} + \frac{D_b}{D_a}\,\frac{Pr(S)}{Pr(K)}\,(D_Q + \frac{E(\varepsilon|Q)}{Pr(S)}).$$

Substituting the explicit form of D_Q and denoting

$$\frac{D_a}{D_b}\,\frac{\phi}{\phi_o}\,\frac{Pr(S)}{Pr(K)} \text{ by } \theta,$$

we transform the above equation to the following form:

$$-(1+\theta)w^2 = -(P+g+h+E(\varepsilon_o|K)) - \theta(w^3+E(\varepsilon|Q) - \frac{E(\varepsilon|Q)}{Pr(S)})$$

$$+ \frac{(D_a-D_b)}{D_a}\,\frac{Pr(S)}{\phi}$$

$$w^2 = \frac{1}{1+\theta}(P+g+h+E(\varepsilon_o|K) + \frac{\theta}{1+\theta}(w^3+E(\varepsilon|Q) - \frac{E(\varepsilon|Q)}{Pr(S)})$$

$$+ \frac{(D_a-D_b)}{D_a}\,\frac{Pr(S)}{\phi(1+\theta)}$$

$$= P+g+h+E(\varepsilon_o|K) + \frac{\theta}{1+\theta}\,\{w^3-(P+g+h+E(\varepsilon_o|K)$$

$$+ \frac{(Pr(S)-1)}{Pr(S)}\,E(\varepsilon|Q)\} - \frac{(D_a-D_b)}{D_a}\,\frac{Pr(S)}{\phi(1+\theta)}.$$

Substitution of $w^3 = P-T+\hat{g}$ gives

$$w^2 = P+g+h+E(\varepsilon_o|K) - \frac{\theta}{1+\theta}\,[T+h+g-\hat{g}+E(\varepsilon_o|K) + \frac{1-Pr(S)}{Pr(S)}\,E(\varepsilon|Q)$$

$$- \frac{D_a-D_b}{D_a}\,\frac{Pr(S)}{\phi(1+\theta)}.$$

Using the relation, $E(\varepsilon) = Pr(S)E(\varepsilon|S) + Pr(Q)E(\varepsilon|Q) = 0$, we can write $E(\varepsilon|S)$ as—

$$E(\varepsilon|S) = -\frac{(1-Pr(S))E(\varepsilon|Q)}{Pr(S)}.$$

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Then, w^2 is given by (10).

$$(10)\quad w^2 = P+g+h+E(\varepsilon_o|K) - \frac{\theta}{1+\theta}[T+g+h-\hat{g}+E(\varepsilon_o|K) - E(\varepsilon|S)]$$

$$- \frac{D_a-D_b}{D_a}\frac{Pr(S)}{\phi(1+\theta)}$$

$$\theta = \frac{D_b}{D_a}\frac{\phi_o}{\phi}\frac{Pr(S)}{Pr(K)} > 0.$$

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APPENDIX B

Use of Reported Productivity Measure in the Analyses

The reported productivity is defined as the ratio of individual worker's productivity to a hypothetical best worker's productivity. Because of heterogenous firms and occupations, the value of productivity scores is not directly comparable across firms. In calculating returns to training and productivity growth rates and in interpreting regression coefficients, careful treatment of the productivity score is needed.

In this appendix we examine the conditions under which uses of the reported productivity scores in the calculation of productivity growth and in the regression analysis are justified. In the first section, we consider the cases in which there are systematic biases and measurement errors in reported (relative) productivity scores. In particular, the relationships between true productivity and reported productivity score is assumed to be either in linear form or in log linear form. In the second section, we deal with the case in which respondents (raters) do report the exact relative productivity of the worker and only source of across firm difference is in the best worker's productivity.

The productivity scores for each individual worker in the firm is obtained from the following question:

> Please rate your employee on a productivity scale of 0 to 100, where 100 equals the maximum productivity rating any of your employees in his or her position can attain, and 0 is absolutely no productivity by your employee.

The response to this question depends on the worker's position, the rater's (supervisor or manager's) knowledge and subjective opinion on the worker's performance, and reference group's (best worker's) productivity. Thus, in general, interfirm comparisons of productivity requires the conditions that ensure the productivity to be measured in a cardinal unit.

However, in making statistical inference on particular hypotheses, for example, growth rate of productivity is equal to wage rate growth, cardinality of productivity measure is not required and less restrictive conditions on productivity scores are sufficient to derive our conclusions.

When There Is Systematic Measurement Error

It is reasonable to assume that the reported (relative) productivity is dependent on the firm specific factor, such as rater's taste and knowledge of the individual worker's productivity, the best worker's productivity, and random errors. Denoting the 'i'th workers productivity score in the 'j'th firm in time t by r_{ijt}, we consider two relationships between the reported productivity and the true productivity.

In the first, the relationship is in linear form.

(1) $r_{ijt} = a_j + b_j p_{ijt} + e_{ijt}$

where p_{ijt} is true productivity that is measured in a cardinal unit, a_j is 'j'th firm (rater) specific bias when P_{ijt} is equal to 0, b_j is the increase in reported productivity expected per unit increase in true productivity, and e_{ijt} is a random factor with a 0 mean.

In order to calculate the growth rate of true productivity, $(p_{ijt}$ $p_{ijt-1})/p_{ijt} - 1$, from the reported productivity it is easy to see that the condition, $a_j = 0$ is required. However, b_j need not be identical across firms.

In the second specification the relationship is in log linear form in (2).

(2) $\log r_{ijt} = c_j + d_j \log p_{ijt} + u_{ijt}$.

The productivity growth is defined by

$\exp (\log p_{ijt} - d_j \log p_{ijt-1}) - 1$

$= \exp [d_j (\log p_{ijt} - \log p_{ijt-1}) + u_{ijt} - u_{ijt-1}] - 1.$

Assuming the expected value of $\exp(u_{ijt} - u_{ijt-1})$ is 1, the growth rate obtained from the reported productivity is a consistent estimate of the true growth rate only when d_j is one. However, variations in c_j will not cause a problem because they are cancelled out after taking difference over time.

As these two examples show, the conclusion regarding the relative size of productivity growth rate to wage growth rate is valid if either (1) holds and $a_j = 0$ or (2) holds and $d_j = 1$.

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In the regression analyses in the subsequent chapters, the productivity scores appear on both left-hand and right-hand sides in linear and log linear specifications in various context.

Unlike the computation of growth rates, variation in firm specific coefficients creates problems when productivity data are used in regression analysis. We examine the conditions on the coefficients in (1) and (2) that need to be satisfied in interpreting the estimated coefficients. We do not seek to "identify" the true relationship between the reported productivity and true productivity. Rather, we present the conditions under which the coefficients from regressions can be interpreted in a meaningful manner.

- The following two cases in cross-section data are discussed first:
- Productivity as a dependent variable
- Productivity as an explanatory variable

We assume that when the productivity scores appear in linear form the underlying relationship between the reported productivity and the true productivity is in linear form in (1), and when it appears in log form, the relationship is in the log linear form in (2). Since for both linear and log linear cases the required conditions are exactly the same for a_j and c_j and for b_j and d_j, discussions are confined to the linear case only.

Productivity level as a dependent variable. When the reported productivity is a dependent variable, the regression coefficients on the right-hand side variables can be interpreted as an estimate of the marginal effect on true productivity multiplied by b_j, if b_j is the same at all firms. However, even when b_j is common across firms variations in a_j may yield biased estimates. Bias arises when the firm specific under or over-statement of the productivity is correlated with, for example, the amount of training. If that is the case, negative (positive) association between the rater's bias on a_j and the amount of training causes negative (postiive) bias on the effect of training. Thus, in order to obtain an unbiased estimate of marginal return, variations in a_j need to be uncorrelated with the explanatory variables.

Summarizing the above argument, in order to test statistical significance of the coefficients the following conditions must be satisfied:

- b_j is constant across firms.
- a_j is uncorrelated with the explanatory variables.

Furthermore, to interpret regression coefficients as the marginal effect of the explanatory variables on productivity (p_{ijt}) b_j must be one.

Productivity as an explantory variable. The productivity scores appear on the right hand side of the wage, turnover, and tenure equations. In order to interpret the regression coefficients on the productivity scores, much more restrictive conditions on (1) and (2) are required than in the cases where productivity scores are treated as a dependent variable. First of all, random components e_{ijt} or u_{ijt} in (1) and (2) cause errors in variable bias that tend to understate the size of the coefficients (in absolute terms). For the same reason, heterogenity in a_j or c_j will further increase the size of the bias. Thus, to obtain a consistent estimate of the effect of productivity, heterogenity and random error need to be removed from the sample. When there are more than two observations per firm, firm-specific variations a_j or c_j can be removed by taking within firm differences. This procedure is discussed later in more detail. However, time varying random components, e_{ijt} or u_{ijt}, will not be removed by this procedure. The use of reported productivity scores as explanatory variables will result in downward bias on their coefficients unless measurement error is zero. Also, across firm differences in b_j and d_j are additional source of errors in variable bias. Only condition that removes errors in variable bias is that b_j is constant across firms.

Summarizing the above discussion, when productivity scores are an explanatory variable the conditions needed to justify the test of statistical significance, test of zero coefficient, are as follows:

- There is no time varying random factor (e_{ijt}).
- There is no firm to firm variation in a_j and b_j.
- To obtain unbaised estimates of true marginal effects,
- b_j must be one, but a_j does not have to be zero.

Removing across firm difference. In the regression analyses from the cross sectioned data heterogeneity in productivity measures causes serious bias. However, if the coefficient b_j in (1) is identical across firms and heterogeneity exists only in a_j, and if more than two individual workers are observed per firm, biases in estimation can be removed by using within firm differences of productivity scores.

Suppose two workers are observed in the 'j'th firm. The reported productivity of these two workers may be written as

(3) $r_{1jt} = a_j + b\, p_{1jt} + e_{1jt}$,
(4) $r_{2jt} = a_j + b\, p_{2jt} + e_{2jt}$.

(3) and (4) are the relationships between true productivity and reported productivity for worker 1 and worker 2, respectively. a_j is a 'j'th firm specific measurement bias and b is a common proportionate factor that represents increment in reported productivity associated with true productivity.

When productivity is a dependent variable of the model heterogeneity in a_j cause bias if a_j's are correlated with the explanatory variables and even when correlations are not present, the conventional test statistics obtained from the OLS are invalid.

However, the source of bias can be removed by taking the difference in productivity scores between the two workers. The difference is written as

(5) $r_{1jt} - r_{2jt} = b(p_{1jt} - p_{2jt}) + e_{1jt} - e_{2jt}$.

Regression of the within firm difference in productivity scores on the corresponding difference in the explanatory variables yields unbiased estimates of the coefficients multiplied by the factor of proportionality b. Although because of the presence of unknown factor b, the parameter estimates are identified only up to relative magnitude, statistical significance of the estimated coefficient from the OLS is valid and free of heterogenity bias. When productivity is one of the explanatory variables of the model, the use of within firm (difference) data in (5) does not remove bias because of the presence of measurement error, $e_{1jt} - e_{2jt}$.

When There is No Measurement Bias

Let r_{ijt} be the relative productivity of the 'i'th worker of the 'j'th firm at time t which is measured without errors. By construction r_{ijt} is the ratio of absolute productivity to the best worker's productivity multiplied by 100. This relationship is written as,

(6) $r_{ijt} = p_{ijt}/P_j \times 100$,

where P_{ijt} is individual worker's absolute productivity, and P_j is the best worker's productivity in the 'j'th firm.

Since there are firm-to-firm variations in P_j, comparison of r_{ijt} across firms will not be meaningful. However, even when P_j is unknown, the growth rate of r_{ijt} over time coincides with the growth rate of true productivity, so conclusions regarding relative size of growth rate in reported productivity score to the rate of wage rate growth are independent of the level of P_j.

On the other hand, when productivity is a dependent variable of the model, heterogeneity of P_j tends to bias the parameter estimates. Let the true model of productivity be (7).

(7) $p_{ijt} = X_{ijt}\beta + e_{ijt}$

The use of r_{ijt} in place of P_{ijt} in the regression is actually estimating (8).

(8) $r_{ijt} = [(X_{ijt}\beta + e_{ijt})/P_j]*100$

Without knowledge of P_j the coefficient vector β will not be estimated from the observed data. The only condition that ensures consistent estimation is that P_j is constant across firms, in other words, reported productivity is measured cardinally and comparable across firms. Obviously, this condition is not satisfied by our data.

A convenient model specification from the viewpoint of estimation is that true relationship is in the log form.

(9) $$\begin{aligned} \log p_{ijt} &= \log r_{ijt} + \log P_j - \log 100 \\ &= X_{ijt}\beta + e_{ijt} \end{aligned}$$

After dropping log 100 from the expression the model is rewritten as (10).

(10) $\log r_{ijt} = X_{ijt}\beta - \log P_j + e_{ijt}$

The functional form of this model coincides with the model in (2). In (10), the firm-specific factor C_j in (2) is determined by the log of the best worker's productivity and d_i (in (2)) is restricted to one. In the above expression, firm-specific heterogeneity ($\log P_j$) appears in additive form. It is natural to assume that the productivity of the best worker, P_j, is determined as a function of observable firm characteristics such as industry, occupation, firm size, labor market conditions, and other unobservable factors.

Assuming that the relationship is linear in observed characteristics we write the relationship as follows:

(11) $\log P_j = Z_j\pi + U_j$,

where Z_j is a vector of observable firm specific characteristics and U_j is an unobservable firm-specific factor. Note that some of the components of Z_j may quite well be included in X_{ijt}, because individual worker's productivity (in absolute term) should also depend upon such factors as industry and occupation that are also determinants of the best worker's absolute productivity.

Substitution of (11) into (9) yields (12).

(12) $\log r_{ijt} = X_{ijt}\beta - Z_j\pi - U_j + e_{ijt}$.

If firm-specific random factor is uncorrelated with X_{ijt} and Z_j, and when no element in Z_j is included in X_{ijt}, from the regression of $\log r_{ijt}$ on X_{ijt} and Z_j, we can obtain a consistent estimate of β and π. If a subset of Z_j is also included in X_{ijt}, we can only identify the coefficients in β that correspond to the variables which do not appear in both of X_{jt} and Z_j. However, when U_j is correlated with Z_j and X_{ijt} estimated coefficients from the cross-sectional data are inconsistent.

In order to obtain consistent estimate of β, we need to eliminate unobservable effect U_j. This can be achieved if we have more than two observations on workers per firm. As discussed in the previous section, by taking differences between the two workers in the same firm, the log of the ratio of the reported productivity is written as a linear function of the differences in the explanatory variables in (10). We, however, note that after taking differences the effects of observable firm characteristics, which are common for the two workers, cannot be estimated. Although our discussion is focused on the case in which productivity is a dependent variable of the model, the same argument is applicable to the case in which productivity is one of the explanatory variables.

Implicit assumptions behind the discussions on the results presented in the tables in chapter 3 are summarized in table 1.4. When the productivity scoress appear in linear form, the underlying relationship is assumed to in linear: $r_{ij} = a_j + b_j P_{ij} + e_{ij}$ and when they appear in log form the underlying relationship is log linear: $\log r_{ij} = c_j + d_j \log P_{ij} + u_{ij}$.

TABLE 1.4

ASSUMPTION ON THE RELATIONSHIP BETWEEN
REPORTED PRODUCTIVITY AND TRUE PRODUCTIVITY

Table	Values of a_j	b_j	c_j	d_j	Productivity Score is on the	Model Type
3.1	—	—	common across firms	1	L.H.S.	typical worker
3.2	0	common across firms	—	—	L.H.S.	typical worker
3.3	free	common across firms	—	—	L.H.S.	typical worker
	—	—	free	common across firms (one, when calculating elasticity)	L.H.S.	typical worker
3.4	—	—	free	common across Firms free (one, when calculating elasticity)	L.H.S.	typical worker
3.5	free	common across firms	—	—	L.H.S.	typical worker
3.6	free	common across firms	—	—	L.H.S.	individual worker
3.7	—	—	free	common across firms (one, when calculating elasticity	L.H.S.	individual worker
3.11	0	common across firms	—	—	L.H.S.	individual worker (within firm)
3.14	—	—	free	1	L.H.S.	individual worker (within firm)
3.15	free	common across firms	—	—	L.H.S.	individual worker (within firm)
3.16	—	—	free	1	L.H.S.	individual (within firm)
3.17	free	common across firms	—	—	R.H.S.	individual (within firm)
3.18	free	common across firms	—	—	R.H.S.	individual (within firm)
3.19	free	common across firms	—	—	R.H.S.	individual (within firm)
3.20	free	common across firms	—	—	R.H.S.	individual (within firm)

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NOTES

1. Comparisons of rates of productivity growth and rates of wage growth were made under an assumption that reported productivity was a proportional transformation of true productivity plus a random error. During the first 6 months, reported productivity grew considerably faster than wage rates. After the first 6 months, rates of wage and productivity growth were approximately equal. As with Medoff and Abraham, these results do not take into account reductions in the amount of time others spend training the new employee as the worker gains tenure. Growth rates of productivity net of training costs are inevitably higher than growth rates of productivity alone. These results are very similar to those reported in this paper and are consistent with the theory that is developed in section two.

2. The assumption of asymmetric information is crucial in justifying the firm's dismissal decision. Ohashi (1983) considered a model in which the firm's decision variables are the wage rates in two periods and the critical value for the second period productivity below which the worker is dismissed. Ohashi has shown that when the worker is risk averse the critical value of the second period productivity is less than the second-period wage, and when the worker is risk neutral optimal second period wage does not exist.

In the second period, however, the firm has an incentive to cheat and dismiss workers whose productivity is less than the second-period wage. This type of contract is implementable (in the sense of Grossman and Hart [1983]) if the workers can observe their productivity in the second period and the firm's cost of cheating is larger than the gain from cheating. If the workers are unable to observe their productivities the firm will dismiss the workers whose productivity is less than the wage, i.e., the type of contract Ohashi considered is not implementable.

3. The job of predicting firm-to-firm variations in general training is made harder by the fact that there are thousands of types of general human capital only some of which will have value in a particular firm. To keep things simple, however, the model assumes only one form of general human capital.

4. Studies of quit and layoff rates typically obtain wage elasticity estimates that are considerably below one (Bishop 1981). This implies that the elasticities of stay and keep rates are even lower and that $(D_a \phi w_g^3 Pr(K) D_k - D_b \phi_o G_k)$ is very small.

5. $\phi_o G_k$ may be rewritten as $Pr(K)\eta_o(G_k/w)$. Since both G_k/w, the ratio of the worker's quasi-rent to the wage is small, and $_o$, the wage elasticity of the proportion of new hires that are kept, is small, the third term of (11) will be small.

6. Note that the sample is representative of on-the-job training provided by a group of employers, not the training activity associated with the employment of a group of job seekers during a specified time frame. The sample most likely underrepresents larger employers if the employment of a group of job seekers over a specified period of time were to be considered.

7. In a few cases, employers reported that more than 520 hours (13 weeks times 40 hours a week) had been devoted to a specific training activity during the first 3 months on the job. Although the new hire might have received training from more than one supervisor, it is unlikely that two trainers were simultaneously in one-on-one contact with the new hire. Consequently the computer edit of this data changed all reports of more than 520 hours involved in a training activity to 520.

8. The cost of the trainer was assumed to be two-thirds of the foregone productivity, since formal training often involves more than one trainee. Thus 1.8 = (2/3)1.5 + .8.

9. The index was constructed under an assumption that the four training activities were mutually exclusive. This implies that if the sum of the hours devoted to individual activities is greater than 520, that a reporting error has occurred which overstates investment in training. In the few cases where the sum of hours devoted to training exceeded 520, the training time index was adjusted downward by the ratio of 520 to the sum of the hours reported for individual activities. This procedure reduces the mean of the index by about 10 percent.

10. The interview questions about the productivity of recently hired employees were intended to provide indicators of the relative productivity of one worker at different points in time or two different workers in the identical job. They do not attempt to measure productivity in any absolute sense and therefore are not comparable across firms. Some of the uses made of these data only require that the index be correlated with true productivity. Estimates of the magnitude of training investments that combine time inputs off other staff with the lower productivity of the trainee require an assumption that the index is cardinal and a proportional transformation of true productivity plus a random error. The questions asking for a rating of the productivity of particular workers have remarkably low nonresponse rates. Only 4.4 percent of respondents asked about a particular new hire's productivity during the first 2 weeks responded with a "don't know" or refused to answer. Comparably defined nonresponse rates for other questions about the new hire were 8.2 percent for previous relevant experience, 3.2 percent for age, 6.7 for education, 8.6 percent for time spent in informal training by a supervisor, and 5.7 percent for a 3-question sequence from which starting wage rate is calculated. The low nonresponse rate implies that our respondents felt that they were capable of making such judgments and augurs well for the quality of the data that results.

11. If employer reports of a worker's productivity are equal to an unknown constant times the worker's true marginal product plus a random error, percentage differences in cell means of the productivity index can be interpreted as unbiased estimators of percentage differences in true productivity. If the variations in the productivity scores assigned by supervisors exaggerate the proportionate variations in the true productivity, our estimates of percentage impacts of recruitment source on productivity will be biased upward. Even though it is possible for a worker's true productivity to be negative, the scale was defined as having a lower limit of zero. Floors and ceilings on a scale typically cause measurement errors to be negatively

correlated with the true value. If this were the case, the result would be an understatement of percentage differences between the productivity of new hires and workers who have been at the firm for longer. In our view, this latter type of bias is more likely than the former.

12. This statement is conditional on the assumption that the productivity reports received from employers are a proportional transformation of true productivity plus a random error. Tests of the sensitivity of the comparison between the growth of wage rates and productivity net of training costs to this assumption appear shortly.

13. The following assumptions produce this calculation: employer reports are a constant times true productivity plus a random error, the managerial and co-worker time reported; to be devoted to training is 100 percent devoted to training as reported, the managerial staff members who provide training are paid 1.5 times what workers with 2 years of tenure earn; and the reported lower productivity of new workers relative to those with 2 years of tenure captures the loss of trainee productivity because of training activities.

14. The first three assumptions are the same. The fourth assumption is that the productivity scores that are assigned describe the trainees' contributions to current output when they are not engaged in training activities and when receiving informal training by management or co-workers. During the other two kinds of training activities (formal training and watching others do the job), the trainee is assumed to contribute nothing to current output.

15. When the ratio derived from the 1983 survey is multiplied by the 1982 estimate of value of training in the first 3 months, we estimate that workers with 2 years of tenure spend 5.5 percent of their time in formal training or watching others do the work and that the time others spend training him or her has a value of 9.5 percent of his or her productivity. One minus this latter figure is the appropriate correction factor for the denominator when conservative aggregation assumptions are used. For liberal assumptions the appropriate correction factor is one minus the sum of these two figures.

16. Compensation may grow faster than wage rates early in a worker's tenure if some minimum amount of tenure is necessary before pensions vest or paid vacation can be taken.

17. Even when skills and training are all general in the sense of being useful in other firms, workers with general training will typically be more productive in the firm that has done the training than in other firms. This is because each firm is likely to require a different mix of general skills. The firm that does the training will concentrate on those skills it needs the most, some of which may not be as highly valued by alternative employers. Skills that would be highly valued by an alternative employer may not be taught because others on the staff already fulfill that function or because of some idiosyncracy of the training firm's production technology. The result is that the best fit between a worker's skills and the employer's needs is more likely to be at the firm that initially provides the training. This phenomenon has the effect of giving specificity to the match even when all training is general and of reinforcing the tendency of wages to rise more slowly than productivity net of training cost.

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2.0 THE MAGNITUDE AND DETERMINANTS OF ON-THE-JOB TRAINING

John Bishop

2.1 Introduction

The 1982 employer survey is the first large-scale data set to contain measures of time devoted to training activities, who does the training, and the reported productivity of the employees receiving this training. A stratified random sample of employers was drawn and then at each establishment one or two recent hires were randomly selected and questions were asked about the training they received.[1] The questions about training activities were for the first 3 months of employment and distinguished four different forms of training: (1) watching others do the job, (2) formal training programs, (3) informal individualized training and extra supervision by management and line supervisors, and (4) informal individualized training and extra supervision by co-workers. The employer (or in larger firms the immediate supervisor) was also asked to report on the productivity of the typical individual hired in the job during the first 2 weeks, during the next 10 weeks, and at the end of 2 years at the firm. The employer was also asked to compare the training received and the productivity of the particular new hire being studied to the training and productivity of the "typical" new hire in that job.

2.2 Magnitude and Distribution

The analysis reveals several points about magnitude and cost of the on-the-job training received by new employees. During the first 3 months, the typical new hire spends an average of 47.3 hours watching others do the job, 10.7 hours in formal training programs, 51 hours receiving informal training from supervisors, and 24.2 hours receiving informal training by co-workers. How do the costs and consequences of initial on-the-job training vary by occupation, industry, establishment size, previous relevant job experience, age, and schooling of the employee? First, the gross associations between these job and worker characteristics and training intensity--the share of the worker's potential productivity that is devoted to training in the first 3 months--are examined. Then multivariate models of the determinants of the length and intensity of training are presented.

Occupation

The impact of one's occupation on the amount of on-the-job training typically received by a new employee is examined in table 2.1. The first four rows of the table describe how the average number of hours devoted to four distinct training activities during the first 3 months after being hired varies by occupation. Even jobs that are thought to require little skill--such as service jobs--seem to involve a considerable amount of training during the first 3 months: an average of 33 hours of watching others, 5.7 hours of formal training, 35 hours of informal training by management, and 17 hours of training by co-workers. Other occupations devote considerably more time to training. The distribution of training activities is similar across occupations however. The typical trainee spends most of his training time watching others do the job or being shown the job by a supervisor. Roughly, equal amounts of time are spent in each. Informal training by co-workers is the next most important factor, and formal training provided by specialized training personnel accounts for only 5 to 10 percent of the time the new hire is engaged in a training activity.

The fifth row of the table summarizes this information into an estimate of investment in training during the first 3 months on the job. The index values the time that managers, co-workers and the trainee devote to training and express it in terms of hours of trainee time.[2,3] Training investment for service jobs is estimated to be 130 hours implying that the time invested in training a typical newly hired service worker in the first 3 months is equal in value to about 25 percent (130 hours/520 hours) of that worker's potential productivity during that period. Investments in training are considerably greater in other occupations. Retail (and service sector) sales and blue collar jobs have a mean index of 185 and 200 hours respectively or 35-38 percent of the new employee's potential productivity. Clerical jobs typically required the equivalent of about 300 hours of training or about 45 percent of the new worker's potential output. Professional, managerial, and nonretail sales workers required the equivalent of about 300 hours of on-the-job training or nearly 60 percent of the new worker's potential output.

TABLE 2.1

TRAINING AND PRODUCTIVITY GROWTH OF TYPICAL NEW EMPLOYEES BY OCCUPATION

	Professional	Managerial	Sales not Retail	Retail Sales	Clerical	Blue Collar	Service
Hours Spent in Training in First 3 Months							
Watching others do the job	60.0	65.0	82.8	39.2	50.4	48.1	32.7
Formal training programs	9.1	12.1	23.9	8.2	13.5	9.1	5.7
Informal training by management	76.6	80.4	71.8	48.5	54.6	49.3	35.1
Informal training by co-workers	31.8	23.0	33.9	23.9	26.2	26.8	16.7
Investment in Training Time	293	295	350	185	235	200	130
Weeks to become fully trained if no previous experience	11.1	13.4	9.2	6.5	6.7	9.0	3.4
Increase in Reported Productivity (%)							
Betw. first 2 wks. & next 10 wks.	28	32	50	30	40	32	28
Betw. first 3 mo. & end of year 2	38	33	36	25	32	23	17
New Hire Productivity Penality as a % of Productivity of Wkr. with 2 Yrs. Tenure							
Liberal assumptions	69	69	74	51	60	50	39
Conservative assumptions	58	56	59	44	50	42	33
Ultraconservative assumptions	43	43	43	32	37	30	23
Increase in Real Wage in First 2 Yrs. (%)	5.0	7.7	22.6	9.7	11.5	11.5	3.7
Number of cases	95	112	76	203	429	649	334

NOTE: Sample is limited to jobs for which all the necessary questions on wage rates, training time, and productivity were answered.

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The sixth row of the table reports the geometric mean of the answers to the question "How many weeks does it take for a new employee hired for this position to become fully trained and qualified if he or she has no previous experience in this job but has the necessary school-provided training?" Service jobs are reported to require an average of only 3-4 weeks of training, retail sales, and clerical jobs slightly under 7 weeks and professional and managerial jobs over 10 weeks.[4]

This training seems to have the hoped for result of increasing the productivity of the new employees. The survey asked the employer (or in larger firms the immediate supervisor) to report on the productivity of the typical individual hired in the job after 2 weeks, 12 weeks, and at the end of 2 years at the firm.[5] The reported productivity of new employees increases quite rapidly (by roughly one-third) during the first month or so at the firm (see row 7).[6] Despite the much greater time interval, the percentage increases between the first quarter and the end of the second year (see row craft) are smaller than those during the earlier period for blue-collar, service, clerical, and sales jobs. For these occupations, training investments and learning by doing seem to be large in the first few months on the job but diminish rapidly thereafter. In the higher level, managerial and professional jobs reported increases in productivity are larger between the 3d and 24th month than in the 1st few months. This reflects the more prolonged training period for these occupations. The occupation that devotes the least time to training--the service occupation--is also the occupation with the smallest increase in productivity with tenure. The reported productivity of service workers improves an average of 28 percent in the first month or so and a further 17 percent in the next 21 months. Occupations for which a lot of time is devoted to training in the first 3 months--nonretail sales workers, professionals, clerical workers, and managers--also seem to have larger than average increases in reported productivity as the worker gains in tenure. Clerical workers, for instance, are reported to be improving their productivity by 40 percent in the first month or so and by an additional 32 percent by the end of the second year on the job.

One of the consequences of the heavy investments in the training of new hires is that new employees make significantly smaller contributions to the firm's current output than workers who have been with the firm for a couple of years or more. The time specifically devoted to formal and informal training activities is not the only penalty incurred when a new employee is hired. In most jobs, skills are developed and refined through practice. Learning by doing as it is called may not actually involve spending time away from a directly productive activity. It is costly, nevertheless, for new workers are less productive than experienced workers. Thus the productivity penalty when a new worker is hired has two components: training investments and the lower productivity of the new worker and the time required to raising the new worker's productivity.

Estimates of the short-run productivity penalty when a new worker is hired are presented in the ninth row of the table. This figure is one minus the productivity net of training cost of a typical new hire (see equation (12) on page 1-17). This number provides a rough guide to the magnitude of the adjustment costs associated with expansions carried out by hiring additional workers rather than by scheduling extra hours. We saw in the previous chapter that the other major component of adjustment costs--recruitment and selection costs--tend to amount to only about 1 percent of a year's output by an experienced worker. The new hire productivity penalty is much larger. During just the first 3 months, it is equivalent in value for services workers to an average of about 1 month's output by an experienced worker. For professional, managerial, and salespersons outside the retail and service sector, the penalty averages about 1.65 months of output by experienced workers. The large magnitude of these costs helps explain why employers tend to hire new employees only when the increase in demand is perceived to be long lasting.

Establishment Size

The relationship between establishment size and training is curvilinear (see table 2.2). The very largest and very smallest (10 or fewer employees) establishments invest the greatest amount of time in training. The very smallest establishments invest 43 percent of a new hire's potential productivity (224 hours) during the first 3 months in training, whereas the next largest size category (11-50 employees) invests only 35 percent of the new hire's time. Those with more than 200 employees invest 48 percent of the new

TABLE 2.2

TRAINING AND PRODUCTIVITY GROWTH OF TYPICAL NEW EMPLOYEE BY ESTABLISHMENT SIZE

	0-10	11-50	51-200	201+
Hours Spent in Training in First 3 Months				
Watching others do the job	48.7	45.4	48.3	55.4
Formal training programs	11.8	7.4	9.2	17.0
Informal training by management	59.1	44.4	52.8	48.0
Informal training by coworkers	23.3	24.3	27.5	32.4
Investment in Training Time	224	1835	213	248
Weeks to become fully trained if no previous experience	8.1	6.4	6.1	8.3
Increase in Reported Productivity (%)				
Betw. first 2 wks. & next 10 wks.	29	33	37	49
Betw. first 3 mos. & end of year 2	26	24	26	34
New Hire Productivity Penality as a % of Productivity of Wkr with 2 Yrs. Tenure				
Liberal assumptions	.55	.50	.55	.61
Conservative assumptions	.46	.42	.46	.51
Ultraconservative assumptions	.34	.30	.34	.37
Increase in Real Wage in First 2 Yrs. (%)	12.1	7.3	8.7	9.6
Number of cases	792	678	296	123

NOTE: Sample is limited to jobs for which all the necessary questions on wage rates, training time, and productivity were answered.

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hire's time in training. The curvilinearity remains when other determinants of training are controlled. Reflecting the pattern of investment in training, wage increases also exhibit a curvilinear pattern being bigger in the very smallest and very largest establishments.

Reported increases in productivity do not, however, have a curvilinear pattern. Rather there is a consistent tendency for the reported increases in productivity to be larger at the larger establishments. The very smallest establishments report a 29 percent productivity increase in the first few months and an additional 26 percent increase by the end of the second year. The largest establishments report a 49 percent increase in the first few months and a 34 percent increase during the next 21 months. Such a dramatic contrast between the pattern of training investments (input) and training outcomes is unusual. The relationship between training investment measured in time units, I, (line 5 of tables 2.1-2.7 and returns to that investment, #P, (line 7 or line 8) is described by--

(1) $\Delta \#P = r_t \theta_t I$

where

r_t is the rate of return to training of stayers, and
θ_t is the opportunity cost of time devoted to training.

The lower $\Delta \#P/I$ of tiny establishments implies that either they have a lower r_t or a lower θ_t. It is unlikely that tiny establishments have lower r_t for they have higher turnover and poorer access to capital markets. The probable explanation of their small$\Delta \#P/I$ is a lower opportunity cost of time devoted to training. Opportunity costs are probably lower because small establishments are unable to spread the risk of stocastic demand as well as larger establishments and so must typically operate with a higher ratio of capacity (staff on hand) to demand (staff interacting with a customer or engaged in production). Scheduling of training is also probably more flexible so training can be done during periods of slack work when opportunity costs are low.

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Industry

Industry has a major impact on investments in training (see table 2.3). Mining (primarly coal mining in this sample), retail, and construction em-

TABLE 2.3

TRAINING AND PRODUCTIVITY GROWTH OF TYPICAL NEW EMPLOYEES BY INDUSTRY

Typical New Employees	Mining	Const.	Manuf.	Trans. Utilities	Whole-sale	Retail	Finance	Other Service
Hours Spent in Training in First 3 Months								
Watching others do the job	66.2	47.7	53.0	51.2	55.1	36.2	76.5	49.6
Formal training programs	10.5	8.2	10.9	3.9	14.7	5.7	19.8	12.5
Informal training by management	31.8	47.2	52.8	47.3	56.0	50.0	59.3	54.3
Informal training by co-workers	16.5	20.2	32.4	25.4	28.3	22.6	33.3	21.8
Investment in Training Time	163	180	231	189	248	175	309	214
Weeks to become fully trained if no previous experience	3.4	11.6	8.8	6.7	8.3	5.8	9.9	6.5
Increase in Reported Productivity (%)								
Betw. first 2 wks. & next 10 wks.	13	21	43	32	41	31	45	31
Betw. first 3 mos. & end of year 2	13	21	27	27	31	23	39	25
New Hire Productivity Penality as a % of Productivity of Wkr with 2 Yrs. Tenure								
Liberal assumptions	.40	48	56	52	60	49	70	54
Conservative assumptions	.28	39	47	44	50	42	57	45
Ultraconservative assumptions	.21	29	34	32	36	30	41	33
Increase in Real Wage in First 2 Yrs (%)	2.1	8.3	10.9	9.6	16.2	8.3	9.7	9.4
Number of cases	36	140	247	75	186	596	130	480

NOTE: Sample is limited to jobs for which all the necessary questions on wage rates, training time, and productivity were answered.

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employers give their new employees the least training. In mining and retail jobs, the explanation seems to be that little training is required. It was reported that a worker with no previous experience would become fully trained and qualified in only 2.4 weeks in mining and only 5.8 weeks in retail jobs. Construction workers require 11.6 weeks to become trained, so the small investment by their employers reflect the fact that most new hires already have been trained on previous jobs. The industries that offer the greatest amount of training are financial services, wholesale, and manufacturing. The industries that offer the greatest amount of training also seem to experience the largest increase productivity over the course of the first months and years on the job. The impact of industry on training when occupation and other characteristics of the job and worker are controlled will be examined in a later section.

Relevant Work Experience

The impact of previous relevant experience on training requirements is outlined in table 2.4. For those with less than 1 year of previous relevant experience, training investment is 45 percent of the new hire's potential productivity. When the new hire has 10 years of previous relevant experience, training investment averages 29 percent of potential productivity. This occurs in the face of a strong tendency for the jobs obtained by those with a great deal of relevant experience to be jobs that require a considerably longer training period. Clearly, when employers fill a job that requires a great deal of training of worker with no previous experience, they tend to give preference to candidates that because of their previous experience are less costly to train. Note also that jobs filled by new hires with greater previous relevant experience tend to pay better (see line 10).

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The pattern of productivity and wage increase follow the pattern of investment. Those with the least experience start out considerably less productive, but their productivity grows from this lower base at a faster rate. Their wage rates start lower but rise faster. The new hires with more than 10 years of previous experience, start out more productive and being paid higher wages. Their productivity rises but at slower rates, and they receive no increase in their real wages.[6]

TABLE 2.4

TRAINING AND PRODUCTIVITY GROWTH OF TYPICAL NEW EMPLOYEES BY PREVIOUS RELEVANT EXPERIENCE

Typical New Employees	None	Under 1 Year	1-3 Years	3-5 Years	5-10 Years	More Than 10 Years
Hours Spent in Training in First 3 Months						
Watching others do the job	49.8	53.6	47.0	39.3	43.6	35.4
Formal training programs	11.0	11.2	8.2	11.4	11.1	4.9
Informal training by management	51.7	60.9	47.0	43.9	56.7	41.6
Informal training by coworkers	26.9	27.1	24.1	19.5	21.2	18.7
Investment in Training Time	220	242	185	171	203	149
Weeks to become fully trained if no previous experience	6.3	7.0	6.7	9.1	8.6	11.1
Increase in Reported Productivity (%)						
Betw. first 2 wks. & next 10 wks.	37	35	27	29	29	29
Betw. first 3 mos. & end of year 2	30	29	21	19	21	21
New Hire Productivity Penality as a % of Productivity of Wkr with 2 Yrs. Tenure						
Liberal assumptions	.56	.60	.48	48	51	45
Conservative assumptions	.47	.50	.40	40	43	38
Ultraconservative assumptions	.34	.36	.29	29	32	27
Wage Rate						
Current wage	$ 4.66	5.05	5.62	6.91	6.42	7.90
Increase in real wage	13.9	10.8	8.2	4.7	4.7	0.0
Number of cases	699	382	404	124	193	96

NOTE: Sample is limited to jobs for which all the necessary questions on wage rates, training time, and productivity were answered.

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Age

The association between training received and the age of the new hire is described in table 2.5. The relationship is curvilinear. It is the 25-29-year-old age group that obtains jobs offering the greatest amount of training to typical new hires--235 hours. Teenagers typically take jobs requiring about 206 hours, and those workers over 40 typically take jobs requiring the least training--156 hours. Productivity growth and wage increases seems to follow on an irregular pattern that is roughly curvilinear with a peak in the 20-24 age group. The average wage of a worker with 2 years of tenure in the firm is curvilinearly related to age with the peak in the 30-39 age bracket.

Schooling: Type and Amount

The relationship between type and amount of schooling of the new hire and the on-the-job training typically received by the typical worker is explored in table 2.6. One would expect schooling to be positively related to the rate at which a new hire can learn new skills. This leads one to hypothesize that employers will tend to select the better educated job applicants for jobs that require a great deal of training. When the job being filled will require a great deal of training if the new hire has no experience, we would also expect employers to attempt to reduce training costs by giving preference to the graduates of relevant vocational training programs.

Both of these hypotheses are supported by the data. People with more schooling and with a vocational component to their schooling take jobs that have longer training periods for inexperienced workers and that offer more intensive training during the first 3 months on the job. High school dropouts with no vocational training typically get jobs in which training investments in the first 3 months are only 22 percent of the new hire's potential productivity. Graduating from high school raises training to 38 percent of the new hire's potential productivity. Getting vocational training in high school raises training to 47 percent of potential productivity and vocational education at a 2-year college or technical institute raises it further to 52 percent. College graduates with a liberal arts degree get only slightly more training--54 percent of their potential productivity. College graduates who

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TABLE 2.5

TRAINING AND PRODUCTIVITY OF TYPICAL NEW EMPLOYEES BY AGE

Typical New Employees	16-19	20-24	25-29	30-39	40+
Hours Spent in Training in First 3 Months					
Watching others do the job	43.7	52.6	52.0	45.5	38.9
Formal training programs	8.9	7.8	17.2	12.1	2.9
Informal training by management	54.7	52.8	58.4	45.9	43.3
Informal training by coworkers	23.8	29.4	23.1	23.3	20.4
Investment in Training Time	206	220	235	192	156
Weeks to become fully trained if no previous experience	5.6	7.4	7.4	8.2	7.0
Increase in Reported Productivity (%)					
Betw. first 2 wks. & next 10 wks.	33	38	30	31	28
Betw. first 3 mos. & end of year 2	27	29	24	23	23
New Hire Productivity Penality as a % of Productivity of Wkr with 2 Yrs. Tenure					
Liberal assumptions	53	57	56	51	46
Conservative assumptions	45	47	46	42	39
Ultraconservative assumptions	33	34	34	32	28
Wage Rate					
Current wage	$ 4.12	5.25	5.84	6.20	5.80
Increase in real wage	11.8	12.1	9.3	7.5	3.6
Number of cases	346	582	409	332	229

NOTE: Sample is limited to jobs for which all the necessary questions on wage rates, training time, and productivity were answered.

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TABLE 2.6

TRAINING AND PRODUCTIVITY GROWTH OF TYPICAL NEW EMPLOYEES
BY
SCHOOLING

	LT 12		12		13–15		16+	
Typical New Employees	Voc Ed	No Voc Ed	Voc Ed	No Voc Ed	Voc Ed	No Voc Ed	Voc Ed	No Voc Ed
Hours Spent in Training in First 3 Months								
Watching others do the job	30.2	25.6	56.4	45.6	61.3	49.0	84	67.1
Formal training programs	4.5	5.4	17.3	7.3	19.3	15.7	10.7	8.3
Informal training by management	40.0	31.6	53.4	54.0	62.4	51.7	68.7	68.9
Informal training by co-workers	23.8	17.3	31.3	23.5	26.4	23.8	27.1	23.9
Investment in Training Time	158	116	246	199	269	226.5	293	279
Weeks to become fully trained if no previous experience	6.5	4.2	9.7	6.3	11.1	7.3	12.4	11.3
Increase in Reported Productivity (%)								
Betw. first 2 wks. & next 10 wks.	33	24	28	35	34	38	35	37
Betw. first 3 mo. & end of year 2	33	17	28	24	28	30	33	41
New Hire Productivity Penality as a % of Productivity of Wkr with 2 Yrs. Tenure								
Liberal assumptions	51	36	58	52	63	58	68	70
Conservative assumptions	45	31	48	44	51	48	54	58
Ultraconservative assumptions	45	31	48	44	51	48	54	58
Wage Rate								
Current wage	$ 4.20	4.26	5.68	5.16	6.19	5.35	7.65	5.37
Increase in real wage	17.1	9.2	11.3	8.7	10.6	13.6	8.9	7.9
Number of cases	46	154	284	823	134	205	47	105

NOTE: Sample is limited to jobs for which all the necessary questions on wage rates, training time, and productivity were answered.

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concentrated on vocational subjects such as engineering or business receive the greatest amount of on-the-job training--56 percent of a much higher potential productivity.

Productivity growth with tenure seems to be greatest in jobs normally filled by workers with many years of schooling. Although productivity increases for vocational program graduates with 12 or more years of schooling are respectable, graduates of nonvocational programs generally had slightly higher rates of productivity increase despite their somewhat smaller amounts of training investment. The productivity of vocational program graduates probably grows more slowly because they start from a higher base. Evidence for their starting from a higher base is provided by the higher wage rates they are able to command. Graduates of high school vocational programs enter jobs with 10 percent higher wage rates than high school graduates that did not specialize. For those with 13-15 years of schooling, the wage premium for vocational training is 16 percent. College graduates with degrees in engineering, business, or some other vocational subject receive a 41 percent higher wage than liberal arts graduates.

2.3 The Determinants of Training

The amount of training that is provided to typical new hires is influenced by the character of the job and the firm. Two different indicators of training investment are analyzed in a multivariate framework. The answer to the question; "How many weeks does it take for a new employee hired for the position to become fully trained and qualified if he or she has no previous experience in this job but has the necessary school-provided training?" is the first indicator studied. The second is an estimate of the value of the time devoted to training during the first 3 months of a worker's tenure at a firm. Table 2.7 presents the results of the regressions predicting the logarithm of the two measures of training investment. Multiplying a coefficient by 100 gives an estimate of the percentage impact of a right-hand side variable.

Both of the measures of training analyzed are indicators of the resource cost of training a particular individual and not of the learning that has occurred as a result of the training. Factors that raise the payoff to training could be expected to increase both the cost of training (input) and the

TABLE 2.7

THE DETERMINANTS OF THE TRAINING OF THE TYPICAL NEW HIRE

Characteristics	Log Weeks to Become Fully Trained		Log Training Intensity in First 3 Months	
Job Characteristics				
Importance of vocational education	.413	(4.6)	.366	(6.5)
Specific vocational preparation	.021	(.7)	.017	(.6)
General educational requirements	.257	(3.8)	.051	(.8)
Clerical	-.505	(4.4)	.257	(2.3)
Sales	-.224	(1.4)	.616	(4.1)
Retail sales	-.039	(.2)	.419	(2.7)
Professional	-.519	(3.0)	.093	(.5)
Managerial	-.327	(1.9)	-.083	(.5)
Service	-.524	(5.1)	.026	(.3)
Craft	.042	(.4)	.029	(.3)
Log cost of machine	.080	(4.4)	.059	(3.3)
Hours per week	.013	(3.7)	.019	(5.6)
Temporary job	-.287	(3.3)	-.290	(3.7)
Piece rate or commission	.057	(.4)	-.170	(1.2)
Partial incentive	.081	(.8)	.091	(.9)
Trainee Characteristics				
Proportion under 25	-.041	(.3)	.401	(3.3)
Proportion union	.078	(.6)	-.074	(.6)
Proportion construction union	-.038	(.1)	-.372	(1.4)
Employer Characteristics				
Log establishment employment	-.133	(1.7)	-.171	(2.3)
Log employment squared	.018	(1.7)	.029	(2.8)
Log ratio firm/establishment employment	-.016	(.7)	.056	(2.5)
Proportion white collar	.418	(4.0)	.452	(4.3)
Proportion craft	.830	(6.2)	.287	(2.2)
Sales growth last 2 years	-.873	(3.2)	.092	(.4)
Sales growth last 2 years if positive	.926	(3.0)	-.070	(.2)
Market Characteristics				
Hard-to-find reliable unskilled workers	.109	(1.4)	.214	(2.8)
Log alter employers using same skills	-.016	(.9)	-.043	(2.5)
Log labor market size	-.002	(.1)	.038	(1.7)
Standard error of estimate	1.468		1.348	
R squared	.202		.159	

NOTE: The models also contained dummies for industry (construction-mining, manufacturing, transportations-utilities, finance-services), the local unemployment rate, the growth rate of employment in the labor market, and the proportion of all jobs that are part-time. T-statistics are in parentheses to the right of the coefficient.

learning (output) that results. A reduction in the cost of training because the workers hired are fast learners, or the firm has developed an especially effective method of training, can be expected to induce the firm to set higher learning objectives. Either the goals for the level of skill to be achieved will be raised, or the minimum hiring standards for previous experience in the field (and entry-level wages) will be lowered. Cost reductions of this type have an ambiguous effect on the time that is devoted to training. If the firm's response to such a cost reduction is to increase its learning objectives only slightly, an increase in the efficiency of training will lower both the time and money cost of training an individual. If, however, the firm's response to its being 20 percent more efficient at teaching skills is to raise its learning objective by more than 20 percent, the cost of training new hires would go up. In the first case, demand for training is inelastic; in the second case, it is elastic.

Under certain assumptions, the elasticity of demand for training can be calculated by observing the degree to which training rises when the typical weekly hours of the job increase. When such a calculation is performed, demand turns out to be inelastic. Firms that are 20 percent more efficient at teaching a skill do try to teach more, but they do not increase their learning objectives by the full 20 percent. As a result, firms that are particularly efficient at training can and in fact do spend less time on the activity than firms of only average efficiency. One way a firm can be particularly efficient at training is by hiring fast learners and already trained and experienced workers. An inelastic demand for training implies that firms which are unable to recruit fast learners will typically have to devote more time to training. The study finds support for this prediction because the firms that hired many workers under the age of 25 and reported that reliable unskilled workers were hard to find did indeed spend more time training their workers than other firms.

The other determinants of training included in the model are indicators of demand for and the payoff to training (not indicators of cost), so the estimated impact of a variable on training cost will generally be a reasonable proxy for its impact on learning as well. When one looks across jobs rather than across the occupants of a particular job, theory and the empirical work of others predict that on-the-job training is complementary with capital, complementary with the skill level of other workers in the firm, and complementary with previous general and occupationally specific training of new hires. All of these hypotheses are supported. Workers who use expensive machinery typically receive a greater amount of training than other workers. The skill level of other workers seems to have a positive effect on training. Evidence of this is the large positive effects on the amount of training of workers at a firm that has many craftsworkers and/or many white-collar workers.

Jobs for which previous school-provided vocational training is important in selecting new hires tend to involve much more training on-the-job than jobs for which previous school-provided training is not important. Jobs that are considered to require an extensive general educational background also typically involve longer periods of on-the-job training. These results imply that students who take more years of schooling and who obtain vocational training typically find jobs that offer greater on-the-job training as well. When they are filling jobs that require a great deal of training, employers are particularly interested in hiring applicants with a strong educational background.

The expected number of hours the new hire is likely to be working at the firm positively impacts training. Temporary jobs offer significantly less training. Full-time jobs offer more. One would expect turnover to be higher in a position in which many other local employers could make use of the skills required. As expected, such jobs offered less training.

The size of an establishment effects the amount of time that is devoted to training. Large firms and very small firms spend the greatest amount of time training new employees. Two offsetting effects account for this: (1) large establishments have low turnover, which raises the payoff to training and therefore the level of training, and (2) in establishments with only a few employees, fewer opportunities for specialization exist so employees must be taught a broader range of skills. These two effects increase the payoff to training. Periods of slack activity (e.g., no one in the store) are probably more frequent in these very small establishments. During slack periods, the opportunity cost of time devoted to training is probably quite low. This can be expected to increase the time devoted to training.

NOTES

1. In the bulk of the sample, the respondent was the owner/manager of the establishment. In large organizations, the primary respondent was the person in charge of hiring, generally the personnel officer. When the primary respondent was unable to answer a question, he or she was asked if someone else in the organization would have the information and that part of the interview was completed with this other official. Other respondents were: controllers, wage and salary administrators, and line supervisors (for questions about a particular recent hire).

2. Our employer respondents reported that workers with 2 years of tenure in the job averaged between 22 and 50 percent (depending on occupation and other worker characteristics) more productivity than new hires during their first 3 months on the job. This ratio was calculated for each job/worker category and used to place a relative value on co-worker time devoted to training. The management staff members who provide formal and informal training were assumed to be paid 1.5 times the wage of co-workers. Formal training involves both the trainer and trainee's time. Sometimes it is one-on-one and sometimes training is done in groups. It was assumed that the average ratio of trainees to trainers was two and that the value of the trainer's time (including materials cost of training) was twice the wage of a co-worker with 2 years of tenure. When supervisors and co-workers are giving informal training to a new employee, the trainee is almost invariably directly involved in a production activity. Employers report that for informal training, the trainees are typically as productive while being trained as they are when working alone. Consequently, informal training is assumed to involve only the investment of the trainer's time. Thus in units of co-worker time, the value of trainer time is 1.5 (informal training time by managers) plus formal training time plus co-worker training time. Trainer time is then added to trainee time to get total investment equals time watching others plus formal training time plus (ratio of reported productivity of experienced [2 yrs] and inexperienced employees) (trainer time). The use of the ratio to estimate the relative productivity implicitly involves an assumption that the productivity reports received from employers are a proportional transformation of true productivity plus a random error. The unknown factor of proportionality can be different for every job, every firm, and every respondent, but a single respondent always uses the same proportionality factor when answering our questions. If alternatively it was assumed that these reports exagerate the rate of growth of productivity with tenure by a factor of 2, estimates of training investment would be 15 percent lower. Comparisons across occupations or of new hires with different qualifications would not change appreciably.

3. The Becker-Mincer definition of investment in on-the-job training is the difference between the new hire's productivity net of training costs in a job that offers learning opportunities and that same worker's wage in an alternative job that results in no learning or training. Investment in training

time as defined in note two corresponds to the Becker-Mincer definition if it is assumed that the alternative no training wage is equal to the worker's average productivity during the first 3 months of employment. If, instead, it was assumed that the alternative to training wage was equal to reported productivity during the first 2 weeks, estimates of training investment would be 15-26 percent higher.

4. If the arithmetic mean were being reported, these numbers would be considerably larger. Nevertheless,these numbers seem low, especially for professional and managerial jobs.

5. The interview questions about the productivity of recently hired employees were intended to provide indicators of the relative productivity of one worker at different points in time or two different workers in the identical job. They do not attempt to measure productivity in any absolute sense and, therefore, are not comparable across firms. Many of the uses made of these data only require that the index be correlated with true productivity. Estimates of the magnitude of training investments that combine time inputs of other staff with the lower productivity of the trainee require an assumption that the index is cardinal and a proportional transformation of true productivity plus a random error. The questions asking for a rating of the productivity of particular workers have remarkably low-nonresponse rates. Only 4.4 percent of respondents asked about a particular new hire's productivity during the first 2 weeks responded with a "don't know" or refused to answer. Comparably defined nonresponse rates for other questions were 8.2 percent for previous relevant experience, 3.2 percent for age, 6.7 percent for education, 8.6 percent for time spent in informal training by supervisor, and 5.7 percent for a three-question sequence from which starting wage rate is calculated. The low-nonresponse rate implies that our respondents felt that they were capable of making such judgments and augur well for the quality of the data that results.

6. If employer reports of a worker's productivity are equal to an unknown constant times the worker's true marginal product plus a random error, percentage differences in cell means of the productivity index can be interpreted as unbiased estimators of percentage differences in true productivity. If the variations in the productivity scores assigned by supervisors exaggerate the proportionate variations in the true productivity, our estimates of percentage impacts of recruitment source on productivity will be biased upward. Even though it is possible for a worker's true productivity to be negative, the scale was defined as having a lower limit of zero. Floors and ceilings on a scale typically cause measurement errors to be negatively correlated with the true value. If this were the case, the result would be an understatement of percentage differences between the productivity of new hires and workers who have been longer at the firm. In our view, this latter type of bias is more likely than the former.

3.0 IMPACTS OF TRAINING
John Bishop

3.1 Impact of Training on Worker Productivity

New employees experience dramatic increases in productivity in the first 2 years of employment at a firm. A part of this productivity increase is due to learning by doing and would occur even if no formal or informal training is provided. Formal and informal training is responsible for a major portion of the productivity growth, however. What is the rate of return to these conscious efforts to train new employees? Which training methods are most effective?

The 1982 National Employer Survey distinguished four different types of employer-provided training: (1) formal training (provided by a training professional), (2) time spent watching others do the job, (3) informal on-the-job training by supervisors, and (4) informal on-the-job training by co-workers. The impact of each of these distinct training activities on productivity growth during the first 2 years on the job for typical new employees was estimated by including reports of hours typically spent on each activity during the first 3 months in models predicting rates of productivity growth. Since diminishing returns are to be expected, the square of the total cost of training was included in the model. Productivity growth during the first 2 years was defined in 2 different ways: the absolute change in productivity on a 0-100 scale and the log of the productivity growth ratio.

The measures of time spent in specific training activities in the first 3 months on the job are thus really measures of training intensity rather than of aggregate training investment during the first 2 years on the job. Consequently, the reported required length of training--the log of the weeks before a new employee becomes fully trained and qualified--was also included in the model. A full set of controls for job, occupation, and firm characteristics was included in each model. The control variables used were almost identical to the independent variables used in table 2.7.

The results of the logarithmic regressions are reported in table 3.1. The linear regressions are reported in table 3.2. In both models, the coefficient on the square term is negative and statistically significant indicating that

TABLE 3.1

MARGINAL RATES OF RETURN TO TRAINING DURING FIRST TWO YEARS

(logarithmic model)

Type of Training	(100s of hrs.)	Assumed Cost Factor	Marginal Rate of Return when Training Intensity Is:		
			100 hrs/Q	300 hrs/Q	500 hrs/Q
Formal Training	.122*** (2.78)	1.8	33%	11	-12
Watching Others	.143*** (7.03)	.8	108	85	63
Informal OJT by Management	.130*** (3.83)	1.5	47	24	1
Informal OJT by Coworkers	.133*** (4.48)	1.0	77	55	32
Total Training Squared	-.0085** (2.25)				
Length of Training (log)	.066*** (6.08)		44	15	9
R Squared	.189				
Standard Error	.59				

NOTE: Column one reports a regression predicting the change in the log of productivity report +5 which, except for the hours of training activity variables reported in this table, is in all other respects identical to the regressions reported in column two of Table 2.7. The derivation of the assumed cost factors is discussed in note two of chapter 2. Marginal rates of return are calculated assuming that an hour increase in a particular training activity during the first quarter corresponds to a 3-hour increase in that activity during the full 2-year period. Training intensity during the first quarter has an arithmetic mean of 149 and a geometric mean of 100.

*	significant at the 10% level	(two-sided)
**	significant at the 5% level	(two-sided)
***	significant at the 1% level	(two-sided)

TABLE 3.2

MARGINAL RATES OF RETURN TO TRAINING DURING FIRST TWO YEARS

(linear model)

		Assumed Cost	Marginal Rate of Return when Training Intensity Is:		
Type of Training	(100's of hrs)	Factor	100 hrs/Q	300 hrs/Q	500 hrs/Q
Formal Training	3.18 (1.86)	1.8	8%	-4	-17
Watching Others	3.98*** (5.02)	.8	35	23	11
Informal OJT by Management	5.27*** (3.98)	1.5	23	10	-2.5
Informal OJT by Coworkers	5.48*** (4.74)	1.0	39	27	14
Total Training Squared	-.38*** (2.58)				
Length of Training (log)	2.48*** (5.88)		21	7	4
R Squared	.156				
Standard Error	23.2				

NOTE: Column one reports a regression predicting the change in the log of productivity report +5 which, except for the hours of training activity variables reported in this table, is in all other respects identical to the regressions reported in column two of Table 2.7. The derivation of the assumed cost factors is discussed in note two of Chapter 2. Marginal rates of return are calculated assuming that an hour increase in a particular training activity during the first quarter corresponds to a 3-hour increase in that activity during the full 2-year period. Training intensity during the first quarter has an arithmetic mean of 149 and a geometric mean of 100.

* significant at the 10% level (two-sided)
** significant at the 5% level (two-sided)
*** significant at the 1% level (two-sided)

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there are diminishing returns to training intensity. When the square of total training intensity is included in the model, all four of the linear terms for a particular form of training have positive and statistically significant effects on productivity growth. The effect of training intensity on productivity is quite large. An increase in any of the training activities from 0 to 100 raises the worker's productivity by 13 to 15 percent in the logarithmic models and by 4 to 6.6 percent in the linear models. Clearly when training intensity is low, increases in its intensity will produce large increases in a worker's productivity.

The impacts of each type of training are remarkably similar. This was not anticipated for some forms of training (e.g., formal training) have much higher hourly costs than others (e.g., watching others do the work), and this was expected to result in the more expensive forms of training having larger impacts on productivity than the cheaper forms. Our estimates of the hourly cost of each type of training (measured in the units of productivity of a worker with 2 years of tenure on the job is given in the second column of table 3.1 and 3.2.[1] Watching others do the work and reading manuals is the least costly form of training because it involves only the new hire's time, the opportunity cost of which is low. It does not require the time of experienced workers and supervisors. Formal training is assumed to be the most expensive because it requires the time of both the trainee and the trainer. The cost of informal training by supervisors and co-workers lies between these two extremes because the trainee is engaged in production, and only the time of the supervisor and co-worker must be charged off as a cost of training. Given these estimates of the relative costs of different forms of training, the results presented in column one imply that informal training has higher rates of return than formal training. A further implication is that within the informal training category, the highest rates of return are to co-worker training and to training yourself through reading and observation.[2]

Illustrative estimates of marginal rates of return for each form of training are reported in columns three, four, and five. Because the period for which training intensity is measured is much shorter than the period over which productivity growth is measured, these estimates must be based on a maintained assumption about how changes in our measure of training intensity during the first 3 months relate to changes in total hours in that training activity over the course of the rest of the 2-year period. It was assumed that a unit increase in a training activity during the first 3 months was associated with a further 2-unit increase in that training activity during the rest of the 2-year period. This assumption lowers the calculated rate of return by a factor of 3.[3,4]

The estimated marginal rates of return diminish as the intensity of training increases. The mean training intensity for the first 3 months expressed in units of the time of trained workers is 148 hours. As intensity during the first 3 months rises from 100 hours to 300 hours (double the mean) and then to 500 hours (more than triple the mean), the marginal rate of return (ROR) for informal OJT by co-workers drops from 34 to 27 and then to 14 percent in the linear model. The linear model's ROR for watching others drops from 35 to 23 and then 11 percent. The ROR for informal OJT by supervisors goes from 23 percent to 10 percent and becomes a negative 2.5 percent when intensity reaches 500 hours in the first 3 months. Formal OJT is estimated to have a positive marginal rate of return only for ranges of total investment that are below about 1.7 times the mean. Estimated rates of return calculated from models based on logarithmic specifications are considerably higher. At the training intensities that prevail (generally under 200 hours during the first quarter), marginal rates of return seem to be very high. These marginal RORs are not adjusted for turnover or obsolescence and are therefore not directly comparable to the real rates of return to schooling and financial assets that typically lie in the range from 5 to 10 percent. If all training investments are specific to the firm and must therefore be written off if there is turnover, it would require RORs of 30 percent or more to induce the firm to invest in specific training.

The discussion of table 2.2 suggested that rates of return to training might be higher at large establishments than small establishments. The composition of training also changes with establishment size with formal training becoming more common as size increases. This suggests that rates of return to various types of training probably vary with establishment size as well. To examine these issues, the models were respecified so as to allow for three-way interactions between training intensity, size, and the share of training that was formal, watching others, and informal OJT by a co-worker. The specification used was the following:

$$P_{2yr} - P_{2wk} = \underline{BX} + b_1L + \underline{b}_2T + b_3T2 + b_4TxE +$$

$$\underline{b}_5T \cdot \underline{S} + \underline{b}_6T \cdot E \cdot S + u$$

where $\underline{X}$ = a vector of control variables

L = logarithm of the required length of training

T = logarithm of training intensity during the first 3 months

E = logarithm of (Employment/18.5)

$\underline{S}$ = a vector of shares of training that are formal, watching others, and informal OJT by co-workers. The excluded category is informal OJT by managers and supervisors.

P_{2yr} = Productivity of the typical worker at the end of 2 years (absolute value in the linear models and logarithmic in the logarithmic models)

P_{2wk} = Productivity of the typical worker during the first 2 weeks (absolute value in the lear models and the logarithm in the logarithmic models)

The results of estimating these equations are reported in table 3.3. A model that allows only for interactions between total training and size is reported in the first and third column. The coefficient on size interacted with training is positive and statistically significant. The results imply that at a training intensity of 100 hours the elasticity of productivity with respect to training is 0.169 at establishments with 19 employees and about 0.19 for companies with 200 employees. The second column of the table reports a regression that includes both the type of training provided and interactions between size and training type. The positive and significant coefficient on interactions between intensity of training and the share that is watching others do the work or that is part of a formal training program implies that these forms of training have significantly higher rates of return than OJT by supervisors, the excluded training category.

The hypothesis that the size of the establishment differentally effects the rate of return to specific types of training is tested by including size times share times log total training interactions in the model. Two of the

TABLE 3.3

IMPACT OF ESTABLISHMENT SIZE ON MARGINAL RATES OF RETURN TO TRAINING

Variable	Linear Model		Logarithmic Model	
Log Length of Training	2.17***	2.15***	.061***	.060***
(5.2)	(5.2)	(5.2)	(5.6)	(5.6)
Log Intensity of Training	.79	.27	-.131**	-.140***
(.4)	(.4)	(.1)	(2.5)	(2.6)
Log Training Intensity Squared	.50***	.56**	.0326***	0.313***
	(3.0)	(2.0)	(5.0)	(4.7)
Interactions of Log Training Intensity With:				
Log size	.39***	.42**	.0089***	.0052
	(4.7)	(2.5)	(4.2)	(1.2)
Formal share		.21		.028*
		(.3)		(1.7)
Formal share times log size		.66*		.0235**
		(1.7)		(2.3)
Watching others share		1.03**		.0441**
		(2.0)		(2.3)
Watching others share times log size		-.84**		-.0089
		(2.3)		(.9)
Co-worker OJT Share		.80		.0196
		(1.3)		(1.2)
Co-worker OJT Share Times Log Size		.53		.0158
		(1.3)		(1.5)
R Squared	.149	.156	.180	.189

NOTE: The logarithm of employment in 1981 was deviated from its mean of 2.85 (18.5 employees) before being interacted with other variables. Consequently, the coefficients on training intensity and training interacted with formal share, watching other share and co-worker OJT share describe the effects of these variables for an establishment with about 19 employees.

* significant at the 10% level (two-sided)
** significant at the 5% level (two-sided)
*** significant at the 1% level (two-sided)

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three estimated coefficients on these three-way interactions are significant. As the size of the establishment increases, the payoff to formal training rises more rapidly than the payoffs to other forms of training. Increases in establishment size also raise the productivity of informal training by co-workers relative to the payoff to training by supervisors, but the effect is smaller than it is for formal training. Watching others do the work seems to become a less effective learning technique at large companies than at smaller companies. These results help explain why formal training programs are more common at large companies than at small companies.

The discussion so far has assumed that the causation runs from training to productivity growth. It might be argued that when one is examining relationships for a typical worker that firms hiring workers with very low initial productivity will find it profitable to provide more than average amounts of training. Consequently, when initial productivity is not controlled, there may be simultaneity bias in our models. To test for such bias we estimated a structural model of productivity growth using two stage least squares.

The X variables used in estimating the models presented in table 3.1 and 3.2 were divided into two parts: those that theory predicts directly influence productivity growth and those that which influence training intensity, composition, or length without directly affecting rates of productivity growth conditional on training. The variables in this latter category were the number of alternative employers; dummies for industry, growth of employment, growth of sales, size of establishment, size of firm, and wage rate; dummy for wage at or below the minimum wage; dummies for no probationary period and log of length of the probationary period; dummies for not knowing if there is a probationary period, difficulty of firing after probationary period, seniority as a basis of layoff, temporary job, and characteristics of the local labor market. These variables were used as instruments for the training variables. This involves maintaining the hypothesis that these variables influence the cost of training investments, and therefore, the level and composition of training without influencing the rate at which new employees learn. The X variables assumed to have direct impacts on productivity growth were dummies for occupation, the specific vocational preparation (SVP), and the general educational development (GED) that the Dictionary of Occupational Titles (DOT) specified is necessary for the job, percent of work force skilled, percent of work force who are craftsworkers, the importance of vocational education in selection, cost of machinery, unionization, hours worked per week, and characteristics of the hires (i.e., percent under age 25), and an employer response that it is hard to find reliable unskilled workers. When outcomes for particular individuals were being modeled, the new hires' education, sex, and work experience were included in the structural model.

The results for the linear and logarithmic specifications are reported in tables 3.4 and 3.5, respectively. In most cases, estimating by 2SLS rather than OLS has the effect of increasing the magnitude of coefficients but decreasing their statistical significance. Two-stage least squares models that distinguish 4 types of training (models 2 and 3) apparently cannot be successfully estimated in the data. In the 2SLS, models on informal OJT by co-workers are much larger than the coefficients on other types of training and are generally the only ones of the 4 specific training activity variables that are statistically significant. The magnitudes of the coefficients are clearly much too variable to be believable. Attention should therefore be directed at model 1 which does not try to distinguish effects of different forms of training. Here the use of two-stage least squares to estimate the model has the effect of doubling the estimated effects of training intensity and reversing the sign of the coefficient on length of training.

An alternative approach to estimating the impacts of training (one that probably reduces the simultaneity problem) is to examine the productivity growth of particular new hires. Tables 3.6 and 3.7 report the results of estimating model 1, 2, and 3 using productivity data on a particular new hire rather than a typical new hire. Missing data reduces sample sizes by about 100. The variance of productivity growth across firms is larger when actual individuals are the data rather than typical individuals. R squares of the models are slightly higher, however, because characteristics of the worker are included in the structural model of productivity growth. The training variables used in these models were for a typical new hire rather than for that particular new hire. Comparisons of the coefficients reported in table 3.4 to those in table 3.6 and table 3.5-3.7 reveal that substituting data on productivity growth outcomes of particular individuals for data on typical hires

TABLE 3.4

IMPACT OF TRAINING ON PRODUCTIVITY GROWTH OF TYPICAL NEW EMPLOYEES OVER FIRST TWO YEARS

	Two-Stage Least Squares Logarithmic Models					
	Model 1		Model 2		Model 3	
Training	OLS	2SLS	OLS	2SLS	OLS	2SLS
Log Training Intensity					.081*** (5.1)	.234** (2.4)
Training Intensity	.233*** (9.3)	.573** (2.6)				
Formal Training			.133*** (3.1)	.282 (.6)	.039 (1.3)	.083 (.3)
Informal Training by management			.130*** (3.8)	.059 (.2)	.013 (.6)	.047 (.3)
Informal Training by Co-workers			.145*** (4.9)	.656** (2.4)	.079*** (2.9)	.532** (2.1)
Watching Others			.149*** (7.4)	.078 (.4)	.092*** (4.9)	-.039 (.2)
Training Intensity Squared	-.022*** (5.6)	-.049 (1.3)	-.0085** (2.3)	.012 (.3)		
Log Weeks of Training	.058*** (5.4)	-.066 (.9)	.068*** (6.4)	.028 (.4)	.060*** (5.6)	-.024 (.4)
R Squared	.177	.092	.171	.093	.174	.096

NOTE: The other variables included in the structural model of productivity growth were dummies for occupation, percent skilled, percent craftsworkers, SVP, GED, importance of vocational education in selection, log cost of machinery, unionization, percent under 25, hard-to-find reliable workers and hours worked per week. The exogenous predictors of training intensity that are not part of the structural model of productivity growth were number of alternative employers, dummies for industry, growth of employment, growth of sales, size of establishment, size of firm, wage rate, dummy for wage below minimum, dummy for probationary period, log of probationary period, dummy for not knowing probationary period, difficulty of firing after probationary period seniority as basis of layoff, temporary job, and characteristics of the local labor market.

* significant at the 10% level (two-sided)
** significant at the 5% level (two-sided)
*** significant at the 1% level (two-sided)

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TABLE 3.5

IMPACT OF TRAINING ON PRODUCTIVITY GROWTH OF TYPICAL NEW EMPLOYEES OVER FIRST TWO YEARS

Training	Two-Stage Least Squares Linear Models					
	OLS	2SLS	OLS	2SLS	OLS	2SLS
Log Training Intensity					4.1*** (6.6)	13.0*** (3.4)
Training Intensity	9.1*** (9.3)	27.1*** (3.1)				
Formal Training			3.7** (2.2)	12.5 (.7)	-.7 (.6)	-5.2 (.4)
Informal Training by Management			5.3*** (4.0)	10.8 (.9)	-.3 (.3)	4.4 (.7)
Informal Training by Coworkers			6.1*** (5.3)	42.0*** (3.9)	2.9*** (2.8)	32.3*** (3.3)
Watching Others			4.2*** (5.3)	-3.5 (.5)	1.4** (2.0)	-11.2 (1.5)
Training Intensity Squared	-.98*** (6.5)	-2.74* (1.8)	-.39*** (2.6)	-.06 (.0)		
Log Weeks of Training	2.1*** (4.9)	-4.73* (1.7)	2.5*** (6.1)	-1.0 (.4)	2.1*** (5.1)	-3.5 (1.4)
R Squared	.142	.076	.144	.085	.129	.080

NOTE: The other variables included in the structural model of productivity growth were dummies for occupation, percent skilled, percent craftsworkers, SVP, GED, importance of vocational education in selection, log cost of machinery, unionization, percent under 25, hard-to-find reliable workers and hours worked per week. Exogenous predictors of training intensity that are part of the structural model of productivity growth were number of alternative on employers, dummies for industry, growth of employment, growth of sales, size of establishment, size of firm, wage rate, dummy for wage below minimum, dummy for no probationary period, log of probationary period, dummy for not knowing probationary period, difficulty of firing after probationary period, seniority basis of layoff, temporary job, and characteristics of the local labor market.

* significant at the 10% level (two-sided)
** significant at the 5% level (two-sided)
*** significant at the 1% level (two-sided)

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TABLE 3.6

IMPACT OF TRAINING ON PRODUCTIVITY GROWTH OF A SPECIFIC NEW EMPLOYEE

Training	Two-Stage Least Squares Linear Models					
	OLS	2SLS	OLS	2SLS	OLS	2SLS
Log Training Intensity						
Training Intensity	8.7*** (8.3)	34.4*** (3.6)			4.4*** (6.7)	14.4*** (3.3)
Formal Training			3.8*** (2.1)	23.8 (1.3)	-.7 (.8)	7.4 (.6)
Informal Training by Management			3.4*** (2.4)	.2 (.0)	-2.4*** (2.8)	-16.6 (2.4)
Informal Training by Coworkers			4.5*** (3.7)	42.9*** (3.5)	1.3 (1.1)	29.3*** (2.8)
Watching Others			3.6*** (4.3)	4.6 (.6)	.7** (.9)	- 5.7 (.7)
Training Intensity Squared	-1.1*** (6.8)	-4.7*** (2.8)	-.40** (2.5)	-1.2 (.8)		
Log Weeks of Training	1.4*** (3.2)	-5.2* (1.7)	2.0*** (4.4)	.62 (.2)	1.5*** (3.3)	-1.8 (.7)
R Squared	.152	.115	.135	.122	.151	.126

NOTE: The dependent variable is productivity growth reported for a particular new hire from the first 2 weeks on the job until the date of interview or separation. The other variables included in the structural model of productivity growth were dummies for occupation, percent skilled, percent craftsworkers, SVP, GED, importance of vocational education in selection, log cost of machinery, unionization, percent under 25, hard-to-find reliable workers and hours worked per week. These models predict outcomes for specific new hires so they contain the following additional controls: relevant experience and its square, total experience and its square, years of schooling, gender, relevant vocational education, and tenure and tenure squared. Exogenous predictors of training intensity that are part of the structural model of productivity growth were number of alternative on employers, dummies for industry, growth of employment, growth of sales, size of establishment, size of firm, wage rate, dummy for wage below minimum, dummy for no probationary period, log of probationary period, dummy for not knowing probationary period, difficulty of firing after probationary period, seniority basis of layoff, temporary job, and characteristics of the local labor market.

*	significant at the 10% level (two-sided)
**	significant at the 5% level (two-sided)
***	significant at the 1% level (two-sided)

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TABLE 3.7

IMPACT OF TRAINING ON PRODUCTIVITY GROWTH OF A SPECIFIC NEW EMPLOYEE

	Two-Stage Least Squares Logarithmic Models					
	Model 1		Model 2		Model 3	
Training	OLS	2SLS	OLS	2SLS	OLS	2SLS
Log Training Intensity					.089*** (5.2)	.290** (2.6)
Training Intensity	.225*** (8.3)	.741*** (2.9)				
Formal Training			.148*** (3.2)	.258 (.6)	.058* (1.9)	-.182 (.5)
Informal Training by Management			.084*** (2.3)	-.203 (.6)	-.033 (1.9)	-.370** (2.0)
Informal Training by Co-Workers			.120*** (3.8)	.687 (2.1)	.055* (1.9)	.510* (1.9)
Watching Others			.114*** (6.2)	.304 (1.5)	.075*** (3.8)	.133 (.6)
Training Intensity Squared	-.023*** (5.6)	-.090** (2.0)	-.008** (2.0)	.002 (.1)		
Log weeks of Training	+.046*** (3.9)	-.082 (1.0)	.057*** (4.9)	.055 (.7)	.048*** (4.1)	-.007 (.1)
R Squared	.174	.117	.166	.122	.175	.125

NOTE: The dependent variable is productivity growth reported for a particular new hire from the first 2 weeks on the job until the date of interview or separation. The other variables included in the structural model of productivity growth were dummies for occupation, percent skilled, percent craftsworkers, SVP, GED, importance of vocational education in selection, log cost of machinery, unionization, percent under 25, hard-to-find reliable workers and hours worked per week. These models predict outcomes for specific new hires so they contain the following additional controls: relevant experience and its square, total experience and its square, years of schooling, gender, relevant vocational education, and tenure and tenure squared. The exogenous predictors of training intensity that are not part of the structural model of productivity growth were number of alternative employers, dummies for industry, growth of employment, growth of sales, size of establishment, size of firm, wage rate, dummy for wage below minimum, dummy for probationary period, log of probationary period, dummy for not knowing probationary period, difficulty of firing after probationary period, seniority as basis of layoff, temporary job, and characteristics of the local labor market.

*	significant at the 10% level (two-sided)
**	significant at the 5% level (two-sided)
***	significant at the 1% level (two-sided)

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and controlling for personal characteristics leaves estimates of the effects of training essentially unchanged.

This result and the fact that 2SLS increase rather than reduces the estimated effects of training lends support to our general conclusion that marginal rates of return to employer-provided training are very high. The conclusion that marginal rates of return to watching others and co-worker OJT are higher than marginal rates of return to supervisor OJT is robust with respect to this change in specification (the use of productivity growth of particular new hires rather than a typical new hire as the dependent variable).

Effects on Turnover

One would expect more productive workers more likely to be promoted and less likely to be separated involuntarily. Consequently, the amount and nature of training that is typical at a firm should influence turnover. To test this hypothesis, models were estimated predicting the actual tenure, probability of a dismissal, probability of a quit and probability of a promotion of particular new hires. Controls were included for the log of potential tenure and its square, background characteristics of the individual worker, and characteristics of the job, the firm and the local labor market.

The training variables were specified so as to allow a test of three hypotheses. The first hypothesis was that a policy of providing greater amounts of training lowers turnover and increases the propensity to promote new hires. The second hypotheses was that this effect would be strongest at the larger firms where training has larger effects on productivity. The third hypotheses is that because formal training is more visible to the firm providing the training, the employee, and other employers, it tends to raise the quit rate, reduce the dismissal rate, and raise the promotion rate more than other forms of training.

The results are presented in table 3.8. Establishment size was scaled as a ratio to its geometric mean of 18.5 before being logged and interacted with training intensity. Consequently, the coefficient on training intensity

TABLE 3.8

IMPACT OF TRAINING ON TURNOVER AND PROMOTIONS

Training	Log Tenure	Involuntary Separation	Quit	Promotion
Log Length of Training	.011	.004	-.007	.004
	(1.1)	(.6)	(1.0)	(.4)
Log Intensity of Training	-.002	.004	-.006	.040***
	(.1)	(.6)	(.7)	(3.8)
Interactions of Training Intensity With:				
Establishment size	.009*	-.004	-.005	.010**
	(1.8)	(1.3)	(1.2)	(2.1)
Share formal training	.014	-.011	.017*	-.001
	(1.1)	(1.3)	(1.8)	(.1)
Share OJT by co-worker	.004	-.006	.004	-.015
	(.3)	(.8)	(.4)	(1.2)
Share watching others	-.007	.009	-.005	-.010
	(.6)	(1.3)	(.6)	(.9)
R Squared	.658	.050	.049	.108

* significant at the 10% level (two-sided)
** significant at the 5% level (two-sided)
*** significant at the 1% level (two-sided)

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estimates the magnitude of the training intensity's impact on turnover for establishments with about 19 workers. Surprisingly, there is no statistically significant impact of either the length or intensity of training on expected tenure or rates of dismissal or quitting at the small establishments that predominate in the sample. There is a statistically significant interaction between establishment size and training intensity, however. At large companies, a higher training intensity for typical workers is associated with longer tenure. At small companies, the reverse association exists. Effects are very small, however. A doubling of training investment raises expected tenure by only 1.3 percent at a company with 200 employees and lowers expected tenure by roughly the same amount at a company with 2 employees. In these results, we have still another reason why large companies typically make greater investments in training than small companies.

The hypothesis that formal training would have larger effects on turnover than other forms of training is supported by the data. For quit rates, there is a statistically significant difference between the impact of formal and informal types of training. Point estimates imply that informal training reduces the quit rate and that formal training increases the quit rate. This lends support to our hypotheses that formal training is both more useful at other firms and more visible to other employers and that informal training is either in skills specific to the firm or invisible to other employers.

The training provided to typical new hires has a much more significant impact on promotions than it has on turnover. At a company with 19 employees doubling the amount of training raises promotion propensities by 3 percentage points. There is a significant interaction with establishment size. If the establishment has 200 employees, doubling training intensity raises promotion propensities by 4.4 percentage points.

3.2 Impact of Training on Wage Growth

The costs and benefits of investments in on-the-job training are shared by employer and employee. This implies that jobs with a great deal of training will tend to have lower starting wage rates than would otherwise be predicted and higher wage rates once the training is completed. In other words, jobs with a heavy training component--either because it requires great skill or because the people being hired for it are completely inexperienced--will have higher rates of wage growth than other jobs. The more general the training the greater will be the share of training costs that is paid by the new employee and the greater will be the resulting rate of wage growth. Since some types of training are more effective than others, some are more general than others and some are more visible to other employers than others, one would expect different types of training to have different effects on wage growth. Are the impacts of different types of training on wage growth similar in pattern to their impacts on productivity growth? Or, is the pattern of wage growth responses to different types of training more influenced by the generality and visibility of the specific type of training?

These issues were addressed by estimating models similar to those presented in table 3.4-3.7, which predict growth in wage rates over the course of the first 2 years on the job. The first dependent variables studied was the log of the ratio of the firm's current wage for a person in the specified job who had 2 years of tenure to the actual starting wage of a person who had recently been hired for the position. Models predicting this variable control for the effects of wage inflation by including the date of hire in the specification. The results are presented in table 3.9.

The second dependent variable is the log of the ratio of the current wage rate (or most recent wage if there has been a separation) and the starting wage rate for a particular new employee who was hired about a year earlier. These models control tenure of the worker on the date for which wages are reported. The results of predicting this measure of wage growth are reported in table 3.10. Both of the models estimated contain controls for the characteristics of the new hire, the occupation, SVP, and GED of the job, percent of craftworkers and percent of skilled workers at the firm, the cost of machinery used in the job, unionization, importance of vocational training in selection, percentage of the firm's work force under age 25, and reported difficulty in finding reliable unskilled workers.

The first conclusion that can be drawn from an examination of the table is that training does have the hypothesized positive effect on wage growth. The effect is statistically significant in all of the OLS models. Comparisons of these coefficients with the estimates of the impact of training on productivity growth in tables 3.4-3.7, however, reveal training has a much smaller impact on wage growth than it has on productivity growth. In model 1, an increase in training from 0 to 100 hours raises productivity of typical employees by 23 percent in the logarithmic model and 10 percent in the linear model, but raises wage rates by only 2.6 percent (table 3.9). A doubling of the length of training raises productivity by 4 percent, but wage rates by only 0.66 percent. The first 100 hours of training raised the productivity of a specific new hire by 22 percent in the logarithmic model and by 9.5 percent in the linear model, but raised the employees wage growth by only 2 percent (table 3.10). As with productivity growth, estimation using two-stage least squares raises the magnitude of coefficients but decreases their statistical significance.

Comparisons of the coefficients on specific types of training also reveal important contrasts between wage growth and productivity growth responses. All forms of training had roughly equal effects on productivity growth. For wage growth, however, formal training has much larger effects than other forms of training and OJT by co-workers has no effect. Apparently, formal training is less specific to the job and more visible to the employee and other potential employers, and thus workers are more willing to contribute to its costs. The importance of OJT provided by co-workers is apparently underestimated by all concerned, the employee, the supervisor, and other employers.

3.3 Impact of Previous Occupationally Specific Training on Productivity, OJT Requirements, and Turnover

Employers place high priority on hiring individuals with relevant work experience and relevant occupational training. This behavior is based on a belief that those who have had previous training are likely to be more productive and to require less training. Are these beliefs justified? By comparing individuals entering the same job at the same firm who have different amount of previous relevant work experience or different kinds of occupational training at school, the beliefs may be tested. Five specific questions are considered:

TABLE 3.9

IMPACT OF TRAINING ON WAGE GROWTH OF TYPICAL NEW EMPLOYEES
OVER FIRST TWO YEARS

Training	Model 1		Model 2		Model 3	
	OLS	2SLS	OLS	2SLS	OLS	2SLS
Log Training Intensity					.022*** (4.3)	.099*** (2.9)
Training Intensity	.028*** (3.5)	.147* (1.9)				
Formal Training			.043*** (3.1)	.158* (1.1)	.028*** (3.0)	-.118 (1.1)
Informal Training by Management			.020* (1.8)	.042 (.4)	-.003 (.4)	-0.131 (2.5)
Informal Training by Co-workers			.001 (.1)	.002 (.0)	-.014* (1.6)	-.123 (1.5)
Watching Others			.017** (2.5)	.107 (1.7)	.004 (.7)	-.027 (.1)
Training Intensity Squared	-.0023* (1.8)	-.025* (1.9)	-.0011 (.9)	-.015 (1.2)		
Log Weeks of Training	.0082** (2.3)	.010 (.4)	.0098*** (2.8)	.032 (1.5)	.0077** (2.2)	.021 (.9)
R Squared	.197	.181	.198	.182	.205	.185

NOTE: The dependent variable is the log of the ratio of 2nd year and starting wage rates. The other variables included in the structural model of productivity growth were dummies for occupation, percent skilled, percent craftsworkers, SVP, GED, importance of vocational education in selection, log cost of machinery, unionization, percent under 25, hard-to-find reliable workers and hours worked per week. The model also contains the following additional controls: relevant experience and its square, total experience and its square, years of schooling, gender, relevant vocational education, date hired, and dated hired squared. The exogenous predictors of training intensity that are not part of the structural model of productivity growth were number of alternative employers, dummies for industry, growth of employment, growth of sales, size of establishment, size of firm, wage rate, dummy for wage below minimum, dummy for probationary period, log of probationary period, dummy for not knowing probationary period, difficulty of firing after probationary period, seniority as basis of layoff, temporary job, and characteristics of the local labor market.

* significant at the 10% level
** significant at the 5% level
*** significant at the 1% level

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TABLE 3.10

IMPACT OF TRAINING ON WAGE INCREASES OF A SPECIFIC NEW EMPLOYEE

Training	Model 1		Model 2		Model 3	
	OLS	2SLS	OLS	2SLS	OLS	2SLS
Log Training Intensity					.0135*** (2.7)	.035 (1.1)
Training Intensity	.022*** (2.8)	-.009 (.1)				
Formal Training			.027** (2.1)	.212 (1.6)	.014 (1.6)	.033 (.3)
Informal Training by Management			.017 (1.6)	.062 (.6)	-.000 (.1)	-.073 (1.4)
Informal Training by Co-workers			-.002 (.2)	.014 (.4)	-.011 (1.2)	-.071 (.9)
Watching Others			.016** (2.5)	-.025 (.4)	.007 (1.2)	-.070 (1.2)
Training Intensity Squared	-.0019 (1.6)	-.0039 (.3)	-.0011 (1.0)	-.015 (1.3)		
Log Weeks of Training	.0072** (2.1)	.048** (2.1)	.0081** (2.4)	.046** (2.2)	.0068** (2.0)	.047** (2.2)
R Squared	.232	.223	.233	.224	.236	.224

NOTE: The dependent variable is the log of the ratio of current (most recent for those who separate) and starting wage rates. The other variables included in the structural model of productivity growth were dummies for occupation, percent skilled, percent craftsworkers, SVP, GED, importance of vocational education in selection, log cost of machinery, unionization, percent under 25, hard-to-find reliable workers and hours worked per week. Models that predict outcomes for specific new hires contain the following additional controls: relevant experience and its square, total experience and its square, years of schooling, gender, relevant vocational education, and tenure and tenure squared. The exogenous predictors of training intensity that are not part of the structural model of productivity growth were number of alternative employers, dummies for industry, growth of employment, growth of sales, size of establishment, size of firm, wage rate, dummy for wage below minimum, dummy for probationary period, log of probationary period, dummy for not knowing probationary period, difficulty of firing after probationary period, seniority as basis of layoff, temporary job, and characteristics of the local labor market.

*	significant at the 10% level	(two-sided)
**	significant at the 5% level	(two-sided)
***	significant at the 1% level	(two-sided)

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- Does the time required to train a new employee go down if the individual has previous relevant training? Which type of previous training has the bigger effect?
- Is the reported productivity of a new employee higher if the individual has previous relevant training? Which type of previous training has the bigger effect?
- Are probabilities of a quit or discharge related to whether the new employee has previous relevant training? Which type of previous training has the bigger effect?
- Is the wage paid a new employee higher if the individual has previous relevant training? Which type of previous training has bigger effect? Does the firm obtain greater profits if it successfully recruits workers who have previous relevant training? In other words, is the productivity net of training, turnover, and wage costs consistently higher for new hires who have previous relevant training? What type of previous training increases profits the most?

The issues raised by the first four questions are different from those raised by the last. If firms had a policy of not varying the wage rates paid to people in the same job, then perfect and costless information and the lack of specific human capital imply everyone hired by the firm has the same expected productivity net of training costs. People with identical tenure in a particular job but different amounts of previous experience and training often receive different wage rates, however. In our sample--a sample dominated by small establishments--the standard deviation of the log of wage paid to incumbants in a particular job was 0.146. Variation in the wage rates paid for particular jobs accounted for 4 percent of the total variation of starting wage rates in the sample and 5 percent of the variation in the current wage rates of job incumbants. When firms offer different wage rates to different hires, a perfectly competitive labor market is quite consistent with substantial differences in the expected productivity or turnover rates of new employees hired for a specific job. Perfect competition will result in the wage rate of more productive groups being higher by roughly the amount of their greater productivity.

Labor markets are not perfect, however. Skills are often specific to a small number of firms and information about job applicants is incomplete and costly to obtain. In firms that pay the same starting wage to everyone, these problems may result in certain groups of new employees (e.g., those with training from previous employers) being more productive than average. In firms that adjust the starting wage to the perceived competence of the worker, productivity net of wages, training, and turnover costs may vary by identifiable characteristics of the worker.

There are four types of market imperfections that can produce such associations: poor information on previous training, lack of competition amongst employers, cyclical or seasonal variations in hiring standards, and random variation in the quality of workers willing to accept a job at the firm. The lack of good information on the quality of a job applicant's on-the-job training and schooling was a central feature of the framework developed earlier for analyzing on-the-job training. In many cases employers may learn of the existence of previous training and be able to judge its relevance only after the employee has been working at the firm for awhile. Under these circumstances productivity will have a higher association with these later employer reports of the worker's relevant previous experience than it has with assessments of previous training made prior to hiring.

Associations between the profitability of a new hire and an observable characteristic like previous experience can also be produced by lack of competition for workers with skills that are useful at only one or only a few local firms. When OJT or school-provided training develops industry- or occupation-specific skills, and there are only a few firms in the locality that use these skills, employers who do use these skills will not have to pay wages that fully reflect the high productivity of these workers at their firm.

A third circumstance that can produce this effect is significant seasonal or cyclical variation in the quality of the new hires a firm is able to attract. For example, when the economy is in recession, firms are able to hire workers with greater-than-average amounts of previous training and experience and higher-than-average levels of expected productivity. At the peak of the cycle, when labor markets are tight, the employers are often forced to hire workers who have less training and experience and who are less productive. The result is that some of a firm's employees (those hired during a recession) are simultaneously more productive and better credentialed (i.e., have greater training and experience) than other employees. Thus, seasonal and cyclical variations in the tightness of labor markets can produce a positive within-firm correlation between productivity and credentials even if all new hires at any given point in time have identical expected productivity.

A fourth reason is significant random variation in the expected productivity of new hires. Most job seekers have much less information about available jobs than is assumed in models of perfect labor markets. When offered a job, they cannot be sure how good it is. Learning about alternatives takes time and money. The costs of a job search--travel costs, lost earnings, and mental anguish--are considerable, so an unemployed job seeker with one offer in hand will not turn it down unless he or she expects more attractive offers will be forthcoming in the near future. About three-fourths of all unskilled and semiskilled job seekers accept the first job offer they receive. As a result, employers find that some of the time they are able to recruit and hire a worker with exceptionally strong credentials and higher-than-average expected productivity. On other occasions, the best qualified job applicants turn the offers down and the firm must settle for someone with average credentials and expected productivity. Thus, random variation in the expected quality of the new hires may produce a positive correlation between productivity and credentials, even among people doing the same job who are paid the same wage.

The implication of the previous paragraphs is that across workers doing the same job, there should be a positive correlation between (1) realized productivity, net of training, and turnover costs and (2) positively valued credentials such as previous relevant work experience and vocational education. The point has not been that certain background characteristics have a positive association with productivity, but rather that given this positive correlation and the selection mechanisms at work in the labor market, positive associations may continue to exist between these characteristics and job performance even when the job, the employer, and the wage rate are all held constant.[6] The best method of testing for such associations between background and job performance is to compare two individuals at the same firm in the same job and see how differences in reported productivity are related to differences in their background characteristics.

Let us assume that in a sample of people who have been recently hired, job performance (Y_{ij}) depends upon personal characteristics (X_{ij}) and job characteristics (Z_j). Thus we have

(1) $Y_{ij} = BX_{ij} + \theta Z_j + u_{ij} + v_j$

where

Y_{ij} is a vector of outcomes such as training time, supervisor reports of a worker's productivity, or wage rate of employee "i" in job "j",

X_{ij} is a vector of credentials or background characteristics of employee "i" in job "j,"

Z_j is a vector of measurable characteristics of the job (j) including characteristics of the employer,

u_{ij} is a random error that is specific to the individual,

v_j is job specific or respondent specific error.

A problem arises if we estimate equation (1). Because the wage rate and the amount of training received depends upon unmeasured characteristics of the job that are correlated with characteristics of the occupant of that job, the covariance of X_{ij} and v_j is almost certainly nonzero, so biased estimates of coefficients vector B will be produced. This problem can be finessed by estimating a fixed effects model and estimating a model predicting the differences in the outcomes experienced by two people in the same job at the same firm as a function of differences in their background characteristics, as is shown in equation (2).

(2) $Y_{1j} - Y_{2j} = B(X_{1j}-X_{2j}) + u_{1j} - u_{2j}$

where person 1 and 2 both work in the same job "j"

Estimating this model produces unbiased estimates of B if the X_{ij}'s are not correlated with the u_{ij}s.

The sample of jobs for which paired data are available was generated in the following manner. A stratified random sample of 3,712 employers was interviewed. Three hundred of these did not have the time for a long interview, so shortened questionnaires were administered. Employers who received the full questionnaire were asked to select "the last new employee your company hired prior to August 1981 regardless of whether that person is still employed by your company." A total of 818 employers could not provide information for a recent new hire. Most of these firms were small organizations that had not hired anyone in recent memory. The employers that provided information on one new hire were asked to provide data on a second new hire in the same job but with contrasting amounts of vocational education. Of the 2,594 employers that provided data on 1 new hire, 1,511 had not hired anyone else in that job in the last 2 years, and 424 had not hired anyone with a different amount of vocational training for that position in the last 2 years. As a result, data are available for 659 pairs of individuals who have the same job at the same establishment. Missing data on specific questions used in the model further reduced the sample used for estimation to about 480. Most of the establishments from which paired data are available are small. Seventy percent have fewer than 50 employees, and only 12 percent have more than 200 employees.

The hypothesis that will be tested relates to the partial relationship between measures of previous training and experience and various indicators of job performance only controlling characteristics of the job that may vary within the pair and for other background characteristics. All of the available background characteristics--vocational education, previous relevant work experience, total work experience, education, sex, and referral source--was entered separately into the model. The only characteristics that had statistically significant associations with most or all indicators of productivity and required training were relevant vocational education and years of previous relevant work experience. Characteristics of the job-worker match that might influence the outcome were controlled. In all models, controls were entered for hours worked per week, a dummy equal to one when the job was supposed to be temporary, a dummy equal to one when the employee was eligible for subsidy and the employer knew this when the hire decision was made, and a dummy equal to one when the employee was going to school part-time while working. In models of current or most recent reported productivity, wage, and profitability, tenure and tenured squared were both included as controls. The date of the hire and its square were controlled in the models of starting wage rates and profitability in the first 3 months.

Relevant Versus Irrelevant Work Experience

The effects of both relevant and irrelevant job experience on training costs, productivity, turnover, wage rates and profitability are presented in table 3.11.[7] Relevant work experience significantly increased the productivity of new hires and significantly reduced the time required to train them (see columns one and two of table 3.11). Five years of relevant experience raised productivity by 25 percent in the first 2 weeks, by 15 percent over the course of the next 10 weeks, and by 8 or 9 percent at the time of the interview. It also reduced training costs by one-third and raised productivity net of training costs by 44 percent. Because workers with 5 years of relevant experience are so much more productive, their probability of discharge or layoff falls by 65 percent, from 12 percent to about 4 percent. Thus despite their slightly higher quit rate, they have slightly greater expected tenure than new hires who lack relevant experience.

Experience that was not relevant to the job had dramatically different effects on productivity and training costs. Five years of experience considered irrelevant by the employer was associated during the first 3 months on the job with new hires being 3-6 percent less productive. Productivity net of training costs was also about 3 percent lower. Irrelevant experience did not have significant effects on time devoted to training or turnover. It is, however, associated with higher wage rates. The effect of irrelevant experience on the wage is about one-third the size of the effect of relevant experience.[8]

There are probably two reasons why irrelevant experience had a negative effect on productivity. The first reason is that experience of the wrong kind produces habits and skills that must be unlearned when the individual enters a very different setting. The second reason is that skills and knowledge gained in school are forgotten or become obsolescent if they are not used (Kohn and Schooler 1983). When relevant experience is held constant, total experience measures the time period over which the skills that were gained in school have been depreciating through lack of use. Apparently these two effects outweigh beneficial effects from general OJT that is not relevant to the job at the new firm. The fact that the negative impact of irrelevant experience on productivity has disappeared by the end of the first year on the job suggests that the process of remembering the things taught in school and unlearning the habits developed in other settings do not take much more than a year.

TABLE 3.11

EFFECTS OF WORK EXPERIENCE
(In percent)

	Relevant Experience		Total Experience	
Outcomes	1 Year	5 Years	5 Years	R Square
Productivity Net of Training Cost First 3 Months	+10***	+44***	- 3.2*	.206
Productivity				
First 2 weeks	+ 5***	+25***	- 6.0***	.209
Next 12 weeks	+ 3.4***	+15***	- 3.4**	.159
Most recent for full sample	+ 1.8***	+ 8.2***	- .9	.163
Current for stayers	2.0***	+ 8.9***	0	.182
Required Training				
Formal training	- 8*	-35*	.7	.075
Informal by management	- 8***	-36***	+ 3.4	.082
Informal by co-orkers	- 8***	-37***	- 8.0	.056
Total training	- 7***	-33***	- 1.7	.213
Wages				
Starting	1.4***	6.4***	3.6***	.292
Most recent for full sample	1.3***	5.6***	2.3*	.230
Current for stayers	1.8***	9.8***	2.1*	.200
Profitability of Hire During First 3 Months	7***	30***	-12***	.127
Productivity Minus Wage				
Most recent for full sample	.8	3.9	- 3.0*	.054
Current for stayers	.7	3.3	- 2.7*	.078
Turnover				
Tenure	2	8	- .6	.646
Quit	3	15	- 3.0	.054
Discharge or layoff	-15	-65**	10.0	.042

NOTE: Fixed effects regressions run on 455-524 pairs of new hires in the 1982 National Employer Survey. All models contained control variables for whether the worker was currently a vocational education student, years of schooling, vocational education interacted with years of schooling, private vocational education, sex, whether hired in a temporary job, whether the hire was known to be eligible for a subsidy when hired, and current average hours per week. Models for current or most recent wage, productivity, and profitability have additional controls for actual tenure and tenure squared. Models for starting wage and profitability in the first 3 months control for date of hire and date of hire squared. The turnover regressions are based on 510 pairs of new hires for nontemporary jobs and control the log of potential tenure and its square.

* significant at the 10% level (two-sided)
** significant at the 5% level (two-sided)
*** significant at the 1% level (two-sided)

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The contrast between relevant experience's large positive impact on productivity and irrelevant experience's negative impact has some important implications. When one looks across new hires for a specific job, it is the occupation- or industry-specific skills that have the greatest impact on productivity. Thus the key to making work experience pay off is gaining experience and training that are relevant to the career one plans to pursue and entering that career path immediately after leaving school. Changes in a career that do not make use of the occupation- or industry-specific skills that have been accumulated necessarily involve large sacrifices of productivity and income. The longer a particular career path has been pursued, the greater the sacrifice will be.

The Firm Specificity of Skills

The question to be addressed next is the degree to which the skills learned in the first year on a job are useful at other firms in the same industry or that have similar jobs. Fifty-nine percent of employers reported that "almost all" of the skills learned in the job were useful outside the company (1982 National Employer Survey). This does not imply, however, that all of these skills will in fact be used if the individual leaves, because each firm is likely to require a different mix of general skills. The firm that does the training will concentrate on those skills it needs the most, some of which may not be valued as highly by alternative employers. Skills that would be valued highly by other employers in the same industry may not be taught because others on the staff already fulfill that function or because of some idiosyncracy of the training firm's production technology. The best fit between a worker's skills and the employer's need is likely to be at the firm that provides the training. This phenomenon has the effect of giving specificity to the match, even when all training is general and of creating a tendency for worker productivity outside the firm (and therefore the wage) to rise less rapidly than productivity in the firm. Another reason why general skills may not produce equivalent increases in productivity at other firms is that other employers' ignorance of the exact nature of the skills and the consequent likelihood that job assignments do not take full advantage of these skills.

The contrast between the productivity effects of relevant experience at other firms and the effects of tenure at the same firm yields important evidence on the share of start-up training that is firm specific as opposed to usable industry- or occupation-specific training or general training. Productivity differentials due to tenure on the job and relevant experience elsewhere are compared in table 3.12. Estimates of the productivity impact of the first full year of job experience are presented in column one and estimates for the second full year are presented in columns two and three.[9]

Learning occurs rapidly during the first year on the job (productivity rising by 3 percent per month) but slows dramatically in the second year (dropping below 1 percent per month). Our estimates of the productivity impact of experience at other firms are much lower overall and decelerate at a much less rapid rate. Taken at face value, this pattern implies that the skills learned in the first 12 months on a job are almost entirely (more than 90 percent) either specific to the firm or general but not put to use in later relevant jobs. During the second year on the job, a much larger share of the skills learned--possibly as much as three-fourths--is not specific to the firm and is usable at other similar jobs. When models were estimated in which the first year of relevant experience (allowing a unconstrained estimate of its impact), estimates of the first year of relevant previous experience's effect on productivity and wage rates did not become larger. Consequently, the finding that the first year of tenure has much larger effects on productivity than does 1 rather than 0 years of releveant experience is robust to changes in specification of the relevant experience variable. The fact that most of the skills learned during start-up training are not general enough to be used in other similar jobs helps explain why compensation is front-loaded, for example, wage rates rise at a distinctly slower rate than productivity net of training costs during the first year (Bishop and Kang 1984).

Spillovers from Employer Training

We will now compare the impact of previous relevant training on wage rates, its impact on productivity. Starting wage rates were 6.4 percent higher for those with 5 years of relevant experience. The additional pay seems to be considerably smaller than the benefit--a 44 percent increase in

TABLE 3.12

FIRM-SPECIFIC VERSUS OCCUPATION-SPECIFIC TRAINING

Tenure and Relevant Experience	First Year	Second Year	
		Full Sample	Stayers Only
	Productivity Growth Rate		
Tenure at the Firm	38.0	9.5	2.6
Relevant Experience at Other Firms	1.8-2.0	1.7	1.8
	Wage Growth Rate		
Tenure at the Firm	9.0	6.7	5.8
Relevant Experience at Other Firms	1.3-1.8	1.2	1.6

NOTE: Entries for the first year of tenure are the reported average growth of productivity and wage rates for new hires that stay with the firm over the course of the first year. Productivity at the time of the interview is the base for calculating the percentage of change in productivity. All other entries are calculated from the regressions reported in table 3.11. The range reported for the effect of the first year of experience reflects the difference found between the full sample and the stayer sample.

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productivity net of training costs during the first 3 months--that the firm derives from hiring a worker with 5 years of relevant experience. Hiring workers with 5 years of relevant experience reduces losses or increases profits during the first 3 months by an amount equal to 26 percent of the typical new hire's productivity net of training costs (see line 13 of table 3.11).[10] Clearly the firm benefits when it is able to hire workers trained by other firms. How long does this spillover benefit last? Five years of such experience is apparently associated with an increase in the profit margin at the time of the interview that is equal in magnitude to somewhere between 3.3 and 3.9 percent of the worker's potential productivity.[11] The effect is not statistically significant, however. The spillover benefit of hiring already trained workers diminishes with tenure but apparently remains during the second year on the new job. The results suggest that firms hiring workers with relevant experience retain for themselves most of the greater productivity of these workers during the first few months on the job. This means that on-the-job training at firm A not only benefits the employee and employer (as implied by Becker's theory of OJT), but also benefits other employers in the industry who hire workers who quit or are laid off by firm A. In other words, OJT creates an externality--a benefit that is not appropriated by either the trainer or the trainee. The market failure that is implied by this finding is justification for governmental efforts to stimulate the externality creating activity--general on-the-job training.

Effects of Vocational Education

New hires who have received vocational education seem to require smaller amounts of on-the-job training and to be more productive in the first few months on the job. To have these positive effects, however, vocational training must be relevant to the job that the individual occupies. Employees who have had vocational training that is not relevant to the job are slightly less productive in the first 2 weeks and require slightly more training than people who have had no vocational training. Employees who have relevant vocational training were significantly more productive both initially and at the time of the interview and also required less training than those with no vocational training. The impact of relevant vocational education varies considerably by level and provider. Consequently, separate estimates were made of the effects of training received at private and public institutions and of the effects of training received by workers with different levels of schooling (a high school diploma or less, some college, and a 4-year college degree or more). The impacts of relevant vocational education received at a public institution are reported for each of the three categories of educational attainment in columns one and three of table 3.13. The additional impact of receiving one's training at a private institution is reported in column four. The impact of an additional 4 years of schooling is reported in column 5.

The effects of relevant vocational training are largest for those with 1-3 years of college. The statistically significant effects are that it increases productivity in the first 2 weeks by 13 percent, reduces management training time by 35 percent, and reduces overall training time by 22 percent. Vocational training at these institutions produces small increases in quit rates, moderate reductions in involuntary turnover, and small increases in tenure. Overall productivity net of training costs during the first 3 months is increased by a significant 22 percent. Wage rates are a significant 8 percent higher. The fact that productivity net of training cost rises much more than wage rates implies that for those with 1-3 years of postsecondary education, vocational training benefits the employer as well as the new hire. The magnitude of the spillover benefit during the first 3 months is estimated to be 16 percent of productivity net of training costs.

Vocational education obtained in high school apparently has smaller effects on productivity, training requirements, and wage rates than vocational education obtained at 2-year postsecondary institutions. The difference is statistically significant for initial productivity, for informal training by management, and for starting wage rates. College graduates with vocational training get significantly more training than other vocationally trained workers in the same job, but, in other respects, are not significantly different from those with some college. Their overall productivity net of training costs during the first 3 months is no higher than that of workers with no vocational training.

High productivity and significant reductions in training costs result from hiring employees who have been trained at privately controlled

TABLE 3.13

EFFECTS OF RELEVANT VOCATIONAL EDUCATION
(In percent)

Outcomes	Vocational Education with 12 or Fewer Years of School	Vocational Education with Some College	Vocational Education with 4+ Years of College	Extra Impact of Private Vocational Education	Impact of 4 Years of General Education
Productivity Net of Training Cost First 3 Months	+7	+22**	0	+22*	1
Productivity					
First 2 weeks	3*	13**	3	20***	0
Next 12 weeks	2	4	4	7	2
At time of interview	3	1	-10	7	5*
Required Training					
Formal training	-9	+25	+73	-37	-10
Informal by management	-8*	-35***	-19	- 9	8
Informal by co-workers	+4	-26	- 2	-36*	+24**
Total training	-9	-22**	+12**	-20**	3
Wages					
Starting	10***	8***	2	4	0
At time of interview					
Profitability of Hire During First 3 Months	6	16	-17	16	-5
Productivity Minus Wage (at time of interview)	1	1	- 4	2	0
Turnover					
Tenure	-6	10	11	7	- 4
Quit	-18	10	29	- 7	-21
Discharge or layoff	+23	-24	-54	-34	33

NOTE: Fixed effects regressions run on 435 pairs of new hires in the 1982 National Employer Survey for all models included control variables for whether the worker is currently a vocational eduction student, was hired in a temporary job, was known to be eligible for a subsidy when hired, and current average hours per week. Models for current or most recent wage, productivity, and profitability have additional controls for actual tenure and tenure squared. Models for starting wage and profitability in the first 3 months control for date of hire and date of hire squared. The turnover regressions are based on 510 pairs of new hires for nontemporary jobs and control the log of potential tenure and its square. In the first and third columns of the table the *'s report on a hypothesis test of differences between the effect of high school (4-year college) vocational education and the effect of vocational education received at a community college or technical institute.

* significant at the 10% level (two-sided)
** significant at the 5% level (two-sided)
*** significant at the 1% level (two-sided)

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vocational-technical schools or colleges. Compared to students who received their vocational training at public institutions, privately trained students are 20 percent more productive initially and 7 percent more productive at the time of the interview and require 20 percent less training. Their overall productivity net of training costs is 22 percent higher. Their starting wage rates are only 4 percent higher, so the firm benefits considerably when it is able to hire a graduate of a private vocational-technical institution.

Additional years of schooling generally do not have statistically significant effects on productivity, required training, and turnover. The exceptions to this generalization are that schooling is positively related to receiving more informal OJT from co-workers and is positively related to productivity at the time of the interview. These results contradict the claims of Ivar Berg (1971) in the Education and Jobs: Great Training Robbery (1971). The fact that years of schooling has zero impact on initial productivity but a significant impact on productivity after a year suggests that schooling helps the individual learn the job.

3.4 Impact of Training on Productivity: Individual Variations

One-fourth of the total variation of training intensity (hours in training activities in the first 3 months) is variation across people occupying the same position at the same firm. Firms recognize that some new hires require more training than others and adjust their training efforts accordingly. Workers with relevant previous work experience and relevant vocational education require and get less OJT. The fast learners who can achieve a target skill level more quickly may also get less OJT. Those viewed as more promotable often get more training to prepare them for the broader responsibilities in the future. When the company and the job being trained for are held constant, what impact does variation in training have upon productivity, wage rates, turnover, and promotions? The next four sections of this chapter address each of these issues.

An empirical analysis was conducted of the determinants of the shape of an individual's learning curve. The effects of the job occupied and the employer on learning rates are held constant by estimating fixed effects models that compare the learning rates of two different workers hired for the same job. The learning rate or productivity increase was defined in two alternate ways. The logarithmic specification defined the learning rate as the log of the ratio of the individuals reported productivity on a 5-105 scale (5 was added to all productivity estimates) at time 2 divided by the individual's productivity measured on the same scale at time 1. The linear specification treats the arithmetic difference between reported productivity at time one and time two as the dependent variable. The learning rate dependent variables were defined for two different time periods: the productivity difference between the first 2 weeks and the next 10 weeks at the firm and the productivity difference between the first 2 weeks and the date of the interview or separation. Learning results partly just from doing the work, but conscious efforts to train the new employee are important as well. The effectiveness of these processes was hypothesized to depend on characteristics of the company, the job, the worker, and the type of training.[12]

Table 3.14 presents regression models that address how different types of training effect productivity and whether the size of the company influences the payoff to training. Training has significantly larger effects on productivity at large firms than at small firms. In the linear model of productivity growth during the first 3 months, the elasticity of productivity with respect to training is 0.07 at companies with 19 employees and 0.18 at companies with 200 employees. In the logarithmic model, the estimated elasticities are 0.14 at companies with 19 employees and 0.36 at companies with 200 employees.

The longer the time period over which productivity growth is defined the greater is the impact of training intensity. In the linear model of productivity growth up to the date of interview or separation, the elasticity was 0.09 at companies with 19 employees and 0.225 at companies with 200 employees. In these models, the effects of learning by doing are captured by the tenure variable. In the linear model, the elasticity of productivity with respect to tenure was 0.055. Although elasticities with respect to tenure are lower than elasticities with respect to training, the log variance of tenure is consider

TABLE 3.14

PRODUCTIVITY EFFECTS OF ALTERNATIVE FORMS OF TRAINING

(within firm models)

Training	Growth Log Model				Linear Growth Model			
	1st Quarter		Until Interview		1st Quarter		Until Interview	
Log Training	.141***	(3.2)	.214***	(3.1)	4.51**	(2.6)	7.29***	(2.7)
Log Training Times Size	.094***	(3.4)	.126***	(2.7)	2.94***	(2.7)	4.67**	(2.5)
Formal Training (100's of hrs.)	.054	(.9)	.075	(.8)	.0	(.0)	1.3	(.3)
OJT by Supervisors (100's of hrs.)	-.039	(1.0)	-.042	(.6)	-2.9*	(1.9)	-5.4**	(2.1)
OJT by Co-workers (100s of hrs)	-.028	(.6)	-.016	(.2)	.8	(.4)	-1.1	(.3)
Log Tenure			.057**	(2.2)			4.36***	(4.3)
Log Tenure Times Size			-.028	(1.4)			-.82	(1.1)
Log Tenure Times Size Sqared			.016*	(1.7)			.47	(1.4)
R Squared	.065		.097		.030		.122	
Standard Error	.34		.52		13.6		20.8	
Number of Observations	506		495		506		495	

* significant at the 10% level (two-sided)
** significant at the 5% level (two-sided)
*** significant at the 1% level (two-sided)

ably greater, consequently, tenure differences are important determinants of worker productivity. There is apparently some curvilinearity to the impact of firm size on tenure elasticities. Tenure or learning by doing seems to have the greatest effect on productivity at the very smallest firms. These results help explain the observed tendency of large employers to provide more training to their employees than small- and medium-sized employers. This occurs not just because they have lower turnover and lower costs of capital, but also because their training is somewhat more effective (probably because of specialization and economies of scale) at raising the worker's productivity.

Data on the training received by specific new employees were available on only three of the four types of learning activities: formal training, informal training by management, and informal training by co-workers. The clear implication of the results from the linear specification is that the relative amount of training received from supervisors has considerably smaller effects on a worker's relative productivity than the relative amount of training recieved from co-workers or through formal mechanisms. Although the coefficients are not statistically significant, there is also a suggestion in the data that being tapped for additional formal training has a more positive effect on productivity than receiving additional informal OJT by co-workers. Another issue that can be addressed in these data is which workers learn most rapidly, which workers benefit the most from learning by doing, and which workers benefit most from participation in activities that have training or an explicit goal? Productivity growth models were estimated that interacted training and tenure with background characteristics of the new hire. The results of these estimations are presented in table 3.15 and 3.16. Only one background characteristic-received relevant vocational training at a private institution--had significant interactions with training and tenure.

Employer training had a considerably smaller impact on those who had graduated from a relevant training program at a private technical college than on other new hires. Apparently the training provided by these institutions is a close substitute for employer training, and much of the OJT given to recruits from these institutions is redundant.

3.5 The Effect of Training and Higher Productivity on Wage Rate

The issue to be addressed in this subsection is whether firms adjust the individual's wage rates to reflect individual's productivity and training requirements. We have already seen that wage rates are not completely determined by the job occupied. Holding the job constant, offers of starting wage rates and the current wage of job incumbents depend on worker characteristics such as schooling, work experience, and gender. Why does this occur? Is this dependence of wage rates on the productivity characteristics of a worker a consequence of the firm's setting wage rates that reflect the individual's productivity? Or, alternatively, is the dependence a function of wage setting based on a prediction of worker productivity based on schooling and work experience that is not revised to reflect knowledge of the actual productivity of the particular worker?

The second question to be addressed is whether differentials in productivity (relative to one's co-workers) are fully or only partially incorporated into relative wage rates? Information on a worker's effort and productivity are often costly to obtain, and the theory of implicit contracts implies that these information assymetries will often result in only partial adjustment of the wage to productivity. There are at least 5 reasons for this.

The first reason why the contracts that govern the employment relationship may specify only partial adjustment of relative wages to relative productivity is worker risk aversion. It is often the case that observed productivity is a function of unobservables--effort or a random state of nature such as the worker's ability or the territory, machine, or co-worker to which he or she is assigned. Setting up a compensation scheme which varies wages dollar for dollar with realized productivity establishes the correct incentives for effort but forces the worker to accept a great deal of risk. The worker's aversion to risk leads him or her to prefer contracts that are not conditioned

TABLE 3.15

PRODUCTIVITY EFFECTS OF TRAINING AND LEARNING BY DOING

(within firm
linear model)

Training and Other Characteristics	Growth up to Interview or Separation		Growth during First 3 Months	
Training	3.94**(2.1)	-4.30 (1.6)	2.54**(2.2)	4.38** (2.6)
Training Times Size		6.96***(3.7)		4.72***(4.1)
Training Times Size Squared		-.65 (.6)		-1.51** (2.3)
Training Times x Relevant Voc. Ed.		.67 (.8)		.01 (.0)
Training Times Private Voc. Ed.		-1.73 (1.0)		-.86* (1.8)
Training Times Female		1.28 (1.4)		.42 (1.1)
Tenure	4.98* (6.7)	4.72***(3.6)		
Tenure Times Size		-.66 (.8)		
Tenure Times Size Squared		.43 (1.3)		
Tenure Times Relevant Voc. Ed.		-1.59 (1.0)		
Tenure Times Private Voc. Ed.		1.21 (.3)		
Tenure Times Female		-.25 (.2)		
R Squared	.007	.130	.014	.050
Standard Error	19.6	20.8	12.4	13.5
Number of Observations	498	495	526	506

* significant at the 10% level (two-sided)
** significant at the 5% level (two-sided)
*** significant at the 1% level (two-sided)

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TABLE 3.16

PRODUCTIVITY EFFECTS OF TRAINING AND LEARNING BY DOING

(within firm
logarithmic model)

Training and Other Characteristics	Growth up to Interview or Separation		Growth during First 3 Months	
Training	.197***(4.3)	-.191***(2.9)	.124***(4.2)	.144***(3.5)
Training Times Size		.157***(3.3)		.128***(4.4)
Training Times Size Squared		-.0088 (.3)		-.027 (1.6)
Training Times Relevant Voc. Ed.			.012 (.6)	-.0038 (.8)
Training Times Private Voc. Ed.			-.079* (1.9)	-.031***(2.6)
Training Times Female		.030 (1.3)		.010 (1.0)
Tenure	.076***(4.0)	.060* (1.8)		
Tenure Times Size		-.022 (1.1)		
Tenure Times Size Squared		.015* (1.7)		
Tenure Times Relevant Voc. Ed.		-.021 (.5)		
Tenure Times Private Voc. Ed.		.072 (1.8)		
Tenure Times Female		-.010 (.3)		
R Squared	.070	.117	.036	.087
Standard Error	.47	.52	.32	.34
Number of Observations	498	495	526	506

* significant at the 10% level (two-sided)
** significant at the 5% level (two-sided)
*** significant at the 1% level (two-sided)

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so strongly on realized productivity. The optimal contract in such an environment will be a compromise between full and zero incorporation of realized productivity into the wage. Exactly where the compromise is struck depends upon the strength of worker risk aversion, the responsiveness of effort to reward, and the variance of random element (Stiglitz 1974; 1975). If firms can monitor the worker's effort, worker risk aversion will induce firms to offer contracts in which pay is based primarily on effort rather than on realized output (Harris and Raviv 1979).[13] This further reduces the dependence of wages on realized productivity.

Second, productivity differentials between workers at a firm might reflect differences in skills that are specific to the firm or only known to the firm. If the worker is not able to translate high productivity at the current employer into a higher wage offer at another firm, the competitive pressure on the current employer to raise the individual's wage is reduced. Even if all productivity differentials within the firm reflect differences in generalized competence, it is very difficult for other employers to measure these differentials accurately and thus base wage and job offers on them. No one is likely to tell a prospective employer the truth. Self-reports of productivity are probably treated with skepticism. The individual's employer has a positive incentive to speak very positively about the workers he wants to get rid of and negatively about the workers he wants to keep. Most employers are reluctant to talk about prior employees. Separating employees who have felt that they were unable to get a good job because they are getting a poor recommendation from a previous employer have successfully sued that employer. This has made most employers reluctant to talk about their past employees. In an interview, we conducted with the personnel director of Nationwide Insurance, we were told; "We warn our managers all the time. If someone calls you on the phone and asks you about someone who has left the company, you refer them to personnel. You don't say word one to them. You could be put in the position where you are going to be in court some day."

A third reason that differences in relative productivity may not show up in difference in relative wages is that the firm is recognizing the greater output in ways that are not as visible to those outside the company. The only indicator of a worker's relative productivity that is likely to influence another employer is the worker's job classification and relative wage rate.

Wage increases and promotions are often justified on the grounds that they will reduce the probability of losing that employee. But, they also transmit signals to other employers about the employee's productivity, and consequently, raise the wage the promoted employee is likely to be able to obtain elsewhere. This means that as an instrument for retaining the most productive employees, promotions and wage increases are partially self-defeating. Rewards for performance that are not visible to other potential employers such as praise, desirable job assignments, greater autonomy, being able to select subordinates, and opportunities for travel and vacations probably have larger effects on retention and morale than equivalent costly wage increases.

The fourth explanation is the high cost of accurately measuring a particular worker's productivity. In most jobs, objective indicators of productivity simply do not exist. This is why in November 1975, only 1.2 percent of the nation's workers were paid on a piece rate basis and only 1.9 percent on a pure commission basis (Flaim 1976). In most work environments, productivity-based wage setting would have to use subjective evaluations by immediate supervisors. These supervisory assessments are known to contain measurement error. Meta-analyses of supervisor rating studies have found that 0.6 is the upper bound on the coorelation between the ratings given the same worker by two different raters (King, Hunter, and Schmidt 1980). Wage setting in such an environment would take into account the measurement error, and the elasticity of the wage rate with respect to measured productivity will be less than one (see Hashimoto and Yu 1980).

Top managements of large organizations sometimes fear that some line supervisors may abuse the power this kind of wage setting gives them. Supervisors may also misperceive the criteria they are supposed to use. If a union represents the workers, the ability and inclination of management to adjust wages to productivity is reduced even further. As a result, large organizations greatly restrict the range over which wage rates may be varied. A supervisor's perception of a 50 percent productivity differential may translate into only a 1 or 2 percentage point differential in the wage increase that is awarded. In our view, it is the threat of unionization and the difficulty of ensuring that supervisors will carry out instructions correctly that are responsible for the very weak connection between relative productivity and relative wage rates in large establishments. In small ownermanaged firms, unions are not as much of a threat and the owner makes the decision about the wage to offer.

The fifth reason for an elasticity below one is that productivity is not perfectly coorelated over time. The consistency of worker performance is greatest when conditions of work are stable. For adjacent weeks coorelations of output rate for routine tasks run as high as 0.96 (Tiffin 1942; Rambo, Chomiak; and Price 1983) and as low as 0.68 (Rothe 1978) when pay is based on an incentive system. The average correlation for 8 different studies was 0.86. Most jobs are not paid on an incentive, however, and conditions of work are often changing. In more typical environments where pay is not based on an incentive and the work environment is changing, correlations for adjacent weeks ranged from 0.48 (Rothe and Nye 1961) to 0.69 (Rothe 1947), and over 4 studies averaged 0.585. Whether correlations for quarterly or yearly averages would be higher or lower than this can be debated. Using longer time intervals should increase the consistency of performance, but the longer time intervals between measurement will reduce the coorelation (Rambo, Chomiak; and Price 1983). If employers try to set wage rates equal to next periods expected productivity, the lack of performance consistency will result in an elasticity of future wage rates with respect to current productivity that is less than one.

In order to examine the extent to which wages reflect actual differences in productivity, we regressed relative wage rates on realized relative productivity scores, an index of the training actually received, and other worker characteristics. If there is a feedback from realized productivity and training to wage rates, we expect the coefficients on productivity and training to be significantly different from zero. Specifically, we expect the coefficient for productivity to be positive and the coefficient for training to be negative. On the other hand, if the firms do not adjust their wage rate to observed productivity and training investment, the coefficients on these variables will be zero.

Two equations for wage rates, one for starting wages and the other for latest wages, were estimated. The results are presented in table 3.17. The starting wage is generally set before the new hire starts work, so one would not expect it to have a very strong relationship with realized productivity.

TABLE 3.17

IMPACT OF WORKER PRODUCTIVITY ON WAGE RATES

	Starting Wage		Latest Wage	
Training Time (100's of hrs.)	-.019*	(1.89)	-.022	(1.51)
Productivity				
2d week	.084	(1.37)	.045	(.51)
3d-12th week	.020	(.26)	-.000	(.00)
At interview or separation	-.011	(.26)	.215***	(3.63)
Relevant Experience	.0155***	(4.34)	.0059	(1.17)
Relevant Experience Sq. (divided by 100)	-.039***	(4.54)	-.016	(1.38)
Total Experience	.0079***	(4.04)	.0072***	(2.64)
Total Experience Sq. (divided by 100)	-.017***	(3.28)	-.0135*	(1.79)
Years of Schooling	.012***	(3.08)	.012**	(2.16)
Relevant Vocational Education	.039***	(3.21)	.030*	(1.77)
Private Vocational Education	.008	(.28)	.023	(.62)
Female	-.040*	(1.90)	-.029	(.98)
Known to Be TJTC Eligible	-.062	(1.64)	-.165***	(3.10)
Union Referral	.426***	(4.69)	.115	(.90)
Number of Observations	456		456	
R Squared	.353		.306	

NOTE: This table is based on fixed effects models that compares two new hires for the same job at the same firm. Other variables in the model were whether the job was temporary, whether the individual was a student, hours worked per week, whether referred by a relative, and whether subsidized by a program other than TJTC. The model for latest wage also contained tenure and tenure squared. The model for starting wage contained date of hire and the date of hire squared.

*	significant at the 10% level	(two-sided)
**	significant at the 5% level	(two-sided)
***	significant at the 1% level	(two-sided)

This expectation is confirmed by the small size and insignificant coefficients on the three measures of worker productivity. Employers do seem to be able to anticipate when a new hire will require extra training, however, and to offer lower wage rates to new hires who require the extra training. The magnitude of this impact is not particularly large. An increase in training during the first 3 months by the equivalent of one fifth of the new employee's potential productivity reduces the new hire's starting wage by only 2 percent. The small size of this response suggests either that most of the training in the first 3 months is specific to the firm or that the employer has difficulty anticipating how much additional training an inexperienced worker is going to require.

Worker characteristics generally have larger impacts on starting wage rates than on current wage rates. Holding realized productivity and total experience constant, 5 years of relevant work experience raises wage rates by 6.8 percent at the start but by only 2.6 percent at the time of the interview. Being a referral from a union has an extremely large effect on starting wages but a much smaller effect on current wages. This pattern of results--large impacts of worker characteristics and small impacts of realized productivity--confirms our expectation that the main determinants of the starting wage are worker characteristics observable prior to the hiring decision.

Latest wages are clearly a function of both worker characteristics and actual productivity. Total experience, years of schooling, and relevant vocational education all had statistically significant impacts on relative wage rates. Reported productivity at the time of interview or separation also had large statistically significant effects on wage rates. The elasticity of wages with respect to productivity is 0.17 (0.8 x 0.215). The fact that this value is significantly below 1 implies that wages only partially reflect person-to-person variations in productivity on the job. This finding explains why studies that have absolute measures of worker productivity typically find that coefficients of variation for productivity greatly exceed the coefficient of variation of wage rates. Bobko, Karren, and Parkington's (1983) study of 92 insurance counselors found, for instance, that coefficients of variation were 42 percent for the sales of these counselors but only 14.6 percent for their earnings.

The conclusion that relative wage rates at interview or separation depend on realized productivity as well as worker characteristics is subject to challenge, however, if employers set wage rates on the basis of worker characteristics such as recommendations from previous employers and aptitude test scores that are not available to the researcher. If such information is available to the employer and it has a continuing effect on wages even after the new hire has been at the firm for a year, the productivity measures will tend to pick up the effects of these omitted worker characteristics and the coefficients on current and lagged productivity will have a positive bias. We examined the presence of omitted variables in wage equations by jointly estimating the starting and latest wage equations using seemingly an unrelated regression technique. Evidence that some of the determinants of relative wage rates are not included in our models is provided by the fact that there is a positive correlation of 0.3 between the errors of the 2 equations. Any possible bias produced by an omitted characteristic, however, seems to be very small. For the latest wage, it is only the contemporaneously measured productivity variable that has a large positive effect on the wage, and actual productivity in the first 2 weeks and the next 10 weeks show no significant impact. Also, in the starting wage model, it is actual productivity in the first 2 weeks that has the largest positive effect and current productivity shows no significant effect. This pattern of coefficients suggests that (1) omitted worker characteristics are not a significant source of bias of the coefficients on the productivity variables in the model of the latest wage and (2) wages adapt quickly though not completely to the realized productivity of the new worker.

One would not expect all firms to be equally able or inclined to adjust relative wage rates to the realized relative productivity of workers. One would expect large establishments and unionized firms to be less likely to base wage increases on supervisor opinions of a worker's productivity. This hypothesis was tested by entering interactions between current productivity on the one hand and size and unionization on the other into the models predicting a worker's current relative wage (see table 3.18). Both coefficients were negative as anticipated, and the coefficient on the interaction term for size and productivity was significantly negative. The elasticity of the wage with respect to productivity is 0.2 (i.e., 0.8 [0.198 + .052]) at non-union estab-

TABLE 3.18

IMPACT OF WORKER PRODUCTIVITY ON WAGE RATES: INTERACTIONS WITH UNIONIZATION AND SIZE

	Starting Wage		Latest Wage	
Training Time (100's of hrs.)	-.020**	(2.01)	-.017	(1.17)
Productivity First 2 Weeks	.080*	(1.87)	.052	(.79)
Productivity (most recent)	--		.198***	(4.21)
Size Times Productivity	.019	(.73)	-.055*	(1.80)
Union Times Productivity	.179	(1.11)	-.138	(.62)
Union Referral	.382***	(4.08)	.120	(.94)
Hired a Relative	-.041*	(1.93)	-.037	(1.23)
Referral by a Relative	.024	(.41)	-.016	(.19)
Relevant Experience	.0154***	(4.31)	.0064	(1.29)
Relevant Experience Sq. (divided by 100)	-.038***	(4.49)	-.018	(1.48)
Total Experience	.0075***	(3.87)	.0077***	(2.80)
Total Experience Sq. (divided by 100)	-.017***	(3.13)	-.015**	(1.99)
Years of Schooling	.012***	(3.08)	.012**	(2.13)
Relevant Vocational Education	.039***	(3.17)	.026	(1.53)
Private Vocational Education	.004	(.16)	.024	(.63)
Female	-.039*	(1.84)	-.024	(.81)
Known to be TJTC Eligible	-.071*	(1.87)	-.165***	(3.10)
Received JTPA Subsidy	.007	(.19)	-.002	(.03)

NOTE: This table is based on fixed effects models that compares two new hires for the same job at the same firm. Models were estimated using seemingly unrelated regression. Other variables in the model were whether the job was temporary, whether the individual was a student, and hours worked per week. The model for the latest wage also contained tenure and tenure squared. The model for starting wage contained date of hire and the date of hire squared. The weighted R square for the system was 0.332, and the coorelation between the residuals of the 2 equations was 0.39. In the starting wage model, size and unionization are interacted with productivity in the second week. In the latest wage model interactions are with most recent productivity.

*	significant at the 10% level	(two-sided)
**	significant at the 5% level	(two-sided)
***	significant at the 1% level	(two-sided)

lishments with 17 employees. Though the coefficient on the unionization interaction is not statistically significant, it's point estimate implies that a unionized firm of that size would have an wage elasticity with respect to productivity of 0.09. The results imply that the elasticity of the relative wage with respect to relative productivity will be 0.09 at a non-union establishment with 200 employees, -0.02 at a unionized establishment with 200 employees, and 0.02 at a nonunion establishment with 1,000 employees. Clearly the relative wage rates of different workers in the same job do not vary proportionately with their productivity. In medium-sized unionized establishments, and large non-union establishments, there does not seem to be any immediate response of relative wages to relative productivities.

3.6 The Effect of Training and Productivity Growth on Turnover

What impact does the productivity of a worker and the training received by that worker have upon turnover? The findings in the previous section support a view that wage rates and other job rewards are in most cases tied to the job occupied and respond to the perceived competence of individual workers only incompletely. Another way employers may respond to productivity differentials between workers is by promoting the most productive and firing the least productive. Many employment contacts (both explicit and implicit) greatly limit the firm's flexibility in setting wage rates but offer it great flexibility in releasing unproductive new hires during a probationary period that may last as long as 6 months. Why do firms offer labor contracts in which they fire less-productive workers rather than offering them a lower wage? The contract literature has suggested a number of reasons why firms may choose to offer such contracts. As a worker gains tenure on the job, the specificity of the job match increases. Renegotiating wage rates after specific training is completed will be very costly because the gap between the threat points of each party can be quite large and the incentives for strategic behavior are strong (Hasimoto and Yu 1981).

A second reason for such contracts might be morale considerations. Retaining an unproductive worker who has been chastened by receiving a salary cut or demotion may be bad for morale. The bitterness that such an event causes may result in grievances being filed against the company, efforts to organize the firm's employees, further declines in the worker's productivity, damage to the morale and cohesiveness of the work group, and sabotage (Akerlof 1982).

In this subsection, we examine the impact of differentials in realized productivity and differentials in training investment on the differentials in turnover of people occupying the same job. How responsive is turnover to such differentials? At which types of firms is turnover most responsive to productivity and training differentials? Have the firms that are unable to adjust wages to productivity differences compensated for this by being quicker to fire the workers who are less productive? Or, are the types of firms that adjust wages to productivity also more likely to fire the less-productive employees? These issues were addressed by studying a sample of workers who had been recruited for permanent jobs and who stayed at the firm at least 3 months. The effects of the firm's characteristics on the average level of turnover was partialed out by examining differences in subsequent turnover between pairs of workers who had the same job and met the selection criteria noted here. Limiting the sample to those who stayed at the firm at least 3 months means that we have one measure of training investment and two measures of reported productivity that are not contaminated by turnover events. The models therefore characterize the effect of the training provided in the first 3 months and the produc-tivity achieved during that period on subsequent turnover.

Models were estimated predicting differences in the log of actual tenure and probabilities of voluntary and involuntary separations. The results of the analysis are presented in table 3.19. When measures of actual training and productivity were included in the models, almost none of the characteristics of the worker were statistically significant. The sole exception to this was that people recruited through newspaper ads were more likely to be fired and had shorter tenure, school referrals had lower dismissal rates, employer referrals had higher dismissal rates, and women had lower quit rates. By far the most powerful determinant of turnover is reported productivity during the 3d-12th week of employment. When the productivity scale is defined over a range from 0 to 1, workers' productivity in the 3d-12th week has a mean of 0.65 and standard deviation of 0.14. A 1 standard deviation (0.14) rise in the productivity report raises expected tenure by 39 percent at a nonunion company with 19 employees. It lowers the probability of being

TABLE 3.19

IMPACT OF TRAINING AND PRODUCTIVITY ON TURNOVER
(within firm models)

Explanatory Variables	Log Tenure		Involuntary Separation		Quit	
Log Training Intensity	.123* (1.8)	.123* (1.8)	-.146*** (3.3)	-.140*** (3.2)	.029 (.5)	.031 (.5)
Log Training Intensity Times Size	-.014 (.3)		-.042 (1.4)		.015 (.54)	
Productivity 2d Week	-.617** (.3)	-.605** (2.1)	-.440** (1.4)	-.400** (2.2)	.110 (.5)	.180 (.8)
Productivity 3d-12th Week	2.400*** (8.4)	2.367*** (8.3)	-.674*** (3.7)	-.673*** (3.7)	-.490** (2.1)	-.537** (2.3)
Productivity 2d-12th Week Times Size	-.398** (2.3)	-.339*** (2.6)	-.186** (2.1)	-.116 (1.4)	.211* (1.8)	.210** (2.0)
Productivity 3d-12th Week Times Union	-.399 (.5)	-.446 (.6)	1.047** (2.0)	1.146** (2.2)	.600 (.9)	.592 (.9)
Log Starting Wage	-.270 (1.2)		.101 (.7)		-.086 (.5)	
R Squared	.592	.588	.242	.226	.121	.114

NOTE: These models of differences between the tenure and turnover of two workers in the same job have the following control variables: dummies for referral squrce, relevant experience and total experience and their squares, log of potential tenure and its square, years of schooling, gender, relevent vocational education, private vocational education, known to be TJTC eligible when hired, subsidized by JTPA, hours worked per week, and working at the firm while part of a co-op program.

*	significant at the 10% level	(two-sided)
**	significant at the 5% level	(two-sided)
***	significant at the 1% level	(two-sided)

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fired by 9 percentage points and the probabilities of quitting by 7 percentage points. If productivity is 0.14 higher both initially and during week 3-12, expected tenure is 27 percent greater, the probability of being fired is 14 percentage points lower, and the probability of quitting is 4.5 percentage points lower. Less productive workers are more likely to quit, but it is in the probability of being fired or laid off where the really big differences show up.

The responses of turnover to a worker's productivity clearly depend upon the size of the firm and on whether it is unionized. A worker's productivity has a smaller effect on expected tenure at large unionized firms. A 1 standard deviation (0.14) increase in both productivity reports increases expected tenure by 27 percent at nonunion companies with 19 employees, by 13.5 percent at non-union companies with 200 employees, and by 6.7 percent at unionized companies with 200 employees. Size and unionization have very different effects on the two forms of turnover. Most probationary periods in union contracts are for 3 months or less. In our data, 88 percent of the firms with probationary periods had a probationary period of 3 months or less. This probably accounts for the fact that dismissal and layoff probabilities of unionized workers who have 3 or more months of tenure do not depend upon the worker's actual productivity. Dismissal decisions at large nonunion companies, seem to be more sensitive to a worker's productivity than the dismissal decisions at small non-union companies. Quit propensities react to company size in the opposite fashion. At companies with 200 or more employees, there is no tendency for the less productive employees to be more likely to quit. At small companies, there is such a tendency and it is statistically significant.

The primary prediction of human capital theory about job turnover is that workers who have a great deal of specific training should have lower rates of turnover. This proposition applies to workers who have completed their training or whose training is well underway. If the employer has paid for most of the costs of specific training, a significant loss is suffered if a separation occurs, so we would expect the separations over which the employer has control (involuntary separations) to be negatively related to the amount of specific training. If the employee has paid for the specific training, one would expect voluntary separations but not involuntary separations to be negatively related to the amount of specific training provided.

Expected tenure is greater for workers who have received more than the normal amount of training. The elasticity of tenure with respect to training is apparently about 0.12. More intensive training raises expected tenure by lowering rates of involuntary termination. Holding productivity constant, a doubling of training investment during the first 3 months lowers the probability of being fired in the subsequent period by nearly 10 percentage points. Variations across workers in the amount of training received seem to have no effect on quit rates. The fact that additional investments in training reduce involuntary turnover but not voluntary turnover supports our previous finding that most of the training provided in the first months on a job is specific to the firm. Apparently some new hires are recruited for their potential not their experience. The receipt of extra training may reflect a belief in a worker's potential. For these workers low productivity during the first few months is not as negative as would be for someone with previous relevant experience, and very low rates of involuntary turnover result.

3.7 Training, Productivity and the Incidence of Promotions

About one-third of our sample of new hires were promoted before the date of our interview. Consequently, an analysis of promotions was conducted which paralleled the analysis of turnover. The results of this analysis of differences in promotion likelihoods of two recent new hires is presented in table 3.20. As one might anticipate, productivity during the 3d-12th weeks on the job was by far the single most important determinant of an individual's likelihood of promotion. Those who were 15 percent (0.10) more productive than other new hires in that job were 13 percentage points more likely to be promoted.

The coefficients on reported initial productivity are negative but not statistically significant. This implies that low productivity in the initial weeks on a job is not held against a new employee being considered for promotion if learning is rapid and very high levels of productivity are attained. The size of the firm has no effect on how sensitive promotion decisions are to perceptions that a worker is highly productive. There does seem to be a tendency, however, for unionized firms to be considerably less affected by productivity when deciding about promotions than nonunion firms.

TABLE 3.20

IMPACT OF TRAINING AND PRODUCTIVITY
ON PROMOTIONS
WITHIN FIRM MODEL

Explanatory Variables	Model 1	Model 2
Log Training	.087* (1.8)	.105** (2.0)
Log Training Times Size	.089** (2.6)	.090** (2.0)
Productivity 2d Week	-.282 (1.3)	-.199 (.9)
Productivity 3d-12th Week	1.332*** (6.4)	1.276*** (5.8)
Productivity Times Size	.087 (.8)	.098 (.9)
Productivity Times Union		-.957 (1.5)
Log Starting Wage	-.261* (1.8)	-.281* (1.7)
R Squared	.216	.256

NOTE: Model 1 contains only three additional variables: hours worked, log potential tenure, and log potential tenure squared. Model 2 contains the following additional characteristics of the worker: gender, relevant experience, total experience, referral source dummies, years of schooling, relevant vocational education, private vocational education, known to have been a TJTC eligible when hired, subsidized by JTPA, and initially hired as a co-op student. Only the co-op student variable had a statistically significant effect (+) on promotions.

* significant at the 10% level (two-sided)
** significant at the 5% level (two-sided)
*** significicnat at the 1% level (two-sided)

There is a clear tendency for those who receive more intensive training in the first 3 months on a job to have a higher probability of subsequently being awarded a promotion. A doubling of training intensity during the first 3 months is associated with a 7 percentage point higher probablility of promotion at companies with 19 employees. This association is even stronger at large establishments. If the company has 200 employees, a doubling of the training intensity in the first months is associated with a 31 percentage point higher probability of being promoted.

NOTES

1. See 2 of Chapter 2 for a complete description of the derivation of cost factors.

2. Measurement error is probably biasing these coefficients. Our respondent (generally a boss, supervisor, or personnel manager) probably had better knowledge of time spent in formal training and informal training by supervisors than of time spent in other forms of training. This should have resulted in the coefficients on these forms of training having a smaller downward bias than the coefficients on informal training by co-workers and time spent watching others. Correcting for measurement error might raise the coefficients on these last two forms of training by more than it raises the coefficients on formal training. Consequently, the conclusion that the rate of return to the most informal types of training is higher than the rate of return to formal training is probably robust with respect to corrections for measurement error.

3. If training intensity in each of the other seven quarters were identical to the first quarter's training intensity, the cost multiplier would be seven rather then two. The correct multiplier is significantly less than seven because training investments in the later period are not perfectly correlated with training investments in the first quarter and because most employers report the training period to be less than 6 months. Given these facts, the two for one ratio is an assumption that magnifies the cost of the reported differences in training intensity quite dramatically and reduces calculated rates of return by a factor of three.

4. The RORs are the ratio of the yearly increase in productivity divided by an estimate of the cost of the training investments that produced the productivity increase. Turnover and skill obsolescence are not incorporated into the estimate. As an example of the calculation, the formula for informal OJT by co-workers using the coefficients from the linear model in table 3.2 for training intensity equal to 300 hours was as follows:

$$[(.0548 - .000038\ (300)\ (2))\ (2000)] \div [(3)\ (80)] = .267$$

where 80 is the assumed productivity of the co-worker and 3 is the change in training over the 2-year period that is associated with a 1-unit change in training intensity during the first 3 months.

5. This occurs despite the fact that some categories of job applicants may have a higher average productivity level than others. Each firm evaluates its job applicants and offers a job only to have those whose expected productivity exceeds a cutoff point. Firms will be more likely to make job offers to applicants with characteristics (e.g., previous work experience or a strong recommendatiaon from someone the employer trusts) associated with a high productivity level. Workers whose expected productivity is substantially above a firm's productive potential and may choose not to apply at this firm or choose to turn down this firm's job offer. Workers with expected productivity that is below this firm's cutoff point either do not apply (because they know they are not qualified for the job), or they are not offered a job when they do apply. These workers must settle for jobs at firms that offer somewhat less-attractive postions.

6. There is no need for a structural model of the relationship between background and job performance. Structural models of the relation between background and performance in a sample of job applicants cannot be estimated using these data without bias because of the truncated nature of the sample (the applicants who were believed to have low productivity were not hired, so observations on their job performance are not available) (Brown 1982).

7. Relevant experience was measured by asking the employe "How many months of experience in jobs that had some application to the position did (name) have before he or she started working for your company?" Total experience was measured by calculating the amount of time that had passed since the new hire had completed schooling. Included is both time employed in related and unrelated jobs and the time spent unemployed or out of the labor force. When relevant experience is controlled, the coefficients on total experience measure the impact of irrelevant experience. It should be noted that questions about the worker's productivity and training requirements were asked after the question about relevant experience.

8. Note that the effect of 5 years of relevant experience which is not offset by a decline in irrelevant experience is obtained by adding the predicted effect of a simultaneous increase in both relevant experience and total experience. Alexander's (1974) analysis of longitudinal data on earnings from social security files and Hollenbeck and Willke's analyses of 1983 CPS data in this report obtained similar results. Holding the amount of experience at the firm constant, past experience in one's current industry or occupation had larger positive effects on earnings than experience in other industries or occupations.

9. The estimated impact of tenure in the first year is the actual reported increase in productivity of stayers. The regression predicting productivity at the time of separation or interview with tenure and tenure squared is used to estimate the effect of the second year of tenure and the effect of the first and second years of relevant experience. Column two is based on the full sample and column three is based on models estimated in a sample of stayers.

10. This hypothesis was tested by defining for each new hire a measure of relative profitability--productivity net of the wage and training costs--during the first 3 months and then analyzing how worker characteristics influence profitability.

11. Another measure of profitability was defined for the interview date by subtracting proportionate differences in wage rates from proportionate differences in productivity. Differences in the costs of training the worker were not measured beyond the first 3 months, so this variable captures only part of the variations across people in their current profitability to the firm.

12. Implicit in this choice of specification are two maintained hypothesis that are probably violated in the real world: productivity growth does not depend upon the level of productivity in the first 2 weeks (it is solely a function of training and tenure and interactions of firm and worker characteristics with these variables), and training investment and productivity growth are not jointly determined. In fact, it is probably the case that there are diminishing returns to investment in training. If the firm is trying to have its employees attain a target skill level, its probable response to the discovery that a new hire is a slow learner will be to offer extra training. The analysis of variations in training intensity across firms suggested that the elasticity of demand for training is less than one. Across individuals in a firm elasticity is likely to be even lower than it is across firms. This implies that slow learners will get more than the average amount of training and will achieve less than the average level of productivity. Estimates of models that take into account the above problems is left for future work.

13. Evidence that firms care a great deal more about productivity losses arising from lack of effort than they care about equivalent losses arising from ability or skill deficits is not hard to find. A recent survey (Miguel and Foulk, 1984) asked 150 supervisors to describe how they would handle various violations of job expectations. The response categories supplied to them were ignore, discuss if persists, discuss immediately, warning, suspend, and fire immediately. These response categories were assigned numerical values from zero for ignore to five for fire immediately. The typical reaction to a worker who "tries but is 15 percent less productive than other workers with the same training" (1.73) and to a worker who "seems not to be trying but is no less productive than other workers" (1.53) tended to be to discuss it with the worker either immediately or if it persists. A worker who "doesn't try and is 15 percent less productive than others with the same training" was typically in much more serious trouble. Their mean score was 3.07 implying that they would immediately be given a warning, and they would be fired if it persisted.

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4.0 SUBSTITUTABILITY OF WORK-RELATED PREPARATION AND ON-THE-JOB TRAINING

Suk Kang

4.1 Introduction

In the first few months of employment, new hires typically receive a substantial amount of on-the-job training to acquire the necessary job skills and knowledge to become productive members of the firm. In this chapter, we examine the relationship between the improvement in productivity, and on-the-job training in the very early stage of employment based on the National Employer Survey data.

In previous studies of the National Employer Survey data, Bishop (1982) found that in the first 3 months (12 weeks) of employment, new hires spent an average of 50 hours watching others do the job, 12 hours in formal training programs conducted by management, 50 hours in informal training conducted by management, and 25 hours in informal training conducted by co-workers. Time spent in on-the-job training added up to nearly 25 percent of the total work hours in the first 12 weeks. During this period, productivity of new hires increased from 24 percent to 36 percent accounting for nearly one-half of the (absolute) productivity growth in the first 2 years of employment.

The effect of on-the-job training on productivity, however, depends not only on the time spent in on-the-job training, but also on the workers' job preparation before joining the firm. For example, workers in electronics-related jobs who have had engineering in college will be more productive from the beginning and learn job-related skills much faster than those workers who took liberal arts science. Similarly, those workers with relevant training in vocational schools or more work experience will be more productive; the effects of on-the-job training on productivity will depend on workers' past job-related experiences. In this study, we examine the impact of the three forms of job preparation--formal education, vocational education, and work experience--on the initial levels of productivity, wage rates, and on-the-job training and their impact on improvement in productivity.

Human capital models of on-the-job training by Hashimoto (1981), Hashimoto and Yu (1980), Ohashi (1983), and Bishop and Kang (1984) assert that the firm's decision on the training investment is determined so that the net return from training is maximized. Two factors affecting the return from training are the rate of labor turnover and the relationship between productivity growth and the cost of training. The first factor, the interaction of labor turnover and training decision, is well explored in the studies previously cited and will not be repeated here. The latter factor depends not only on the amount of training provided on the job, but also on the previous employee's work-related experience, initial skill level, innate ability, and vocational and academic education. Although the previous studies briefly discussed the return from the training investment, in the analysis of the model, the effects of those background variables were not given much attention.

The determination of on-the-job training in relation to the previous experience and skill level crucially depends on the degree of substitutability of on-the-job training and various work-related preparation, initial skill level, innate ability, and education. If the skills produced by, for example, education are not replaceable by and complementary to on-the-job training, the return from the training investment for those with better education will be higher, and the resulting investment level for them will be higher than for those with less education. The degree of substitutability is dependent upon the technology employed in the job and, so, should vary by occupation and industry. The degree of substitutability between on-the-job training and training prior to employment is basically an empirical issue, and there is no a priori ground to specify the relationship before scrutinizing the data. In this study, we examine the relationship between the effect of on-the-job training on productivity and its interaction with various work-related experiences and preparations on an empirical basis.

The effects of on-the-job training on productivity should vary by occupation, the skill requirement, and the technology used. Furthermore, the productivity measure employed in the National Employer Survey is defined in terms of relative productivity compared to a hypothetical "best worker" in the same firm and in the same position. Therefore, comparison of productivity across individual workers may not be meaningful if the differences in the measurement in productivity are not properly controlled.

One approach to deal with heterogeneity of measurement is to compare the two workers in the same position in the same firm (see Bishop 1982). However, this approach assumes that the marginal return to training on productivity is equal across firms, occupations, and industries, which may be too severe a restriction. The other approach is to compare workers in similar positions.

In this study, we take the latter approach in controlling heterogeneity of productivity measure. Workers are grouped by occupations and the productivities are compared within the same occupational group. It may be reasonable to assume that the productivity of the workers in the same occupation can be measured by a common scale and that the comparison of the return from training on the productivity growth within the same occupational group is meaningful.

The following questions are posed:

- What is the impact of the three types of job preparations--work experience, academic education, and vocational education--on new hires' productivity? Are there differences by occupation?
- How do employers evaluate workers' previous job-related preparation in terms of wage? Are there positive associations between the factors that raise wage rate and productivity, or improvement in productivity?
- Does vocational training raise workers' wage and productivity? What are the differential effects of vocational education and academic education on wage rate and productivity?
- How much does on-the-job training improve workers' productivity?

We analyzed the National Employer Survey data obtained from telephone interviews of over 3,800 employers. These data contained rich information on recently hired workers--performance on the job, the amount of on-the-job training in the first 12 weeks, skill requirements, previous academic and vocational education, work experience, along with various worker, job, and firm characteristics.

The next section offers three models describing the relationship between previous work experience, on-the-job training, and productivity. The third section describes the data used in the analysis. The estimation results are discussed in the fourth section. Section 5 gives the conclusions of the study.

4.2 Models of Training Decision

The relationship between the various work-related experience and worker productivity may differ by occupation, skill requirement, technology employed by the firm, and industry. The firm's training investment on new hires is determined by the nature of technology, labor market conditions, and the worker's previous work-related preparation. Given the information on these factors, the firm will choose the best training program that yields the highest return on training investment.

In the previous study by Bishop (1982), it was found that, given the occupation and the firm, when two workers with different vocational training are compared, the one with more vocational training required less training to achieve a certain skill level than the one who received less vocational training. This section presents three models based on this observation. These three models predict distinctive relationships between the amount of on-the-job training, improvement in productivity, and the previous job-related training.

In the first model, it is assumed that the initial productivity of those who received better job preparation is higher than less prepared workers, and the same amount of on-the-job training increases productivity much faster than for those workers without preparation. When the return from the investment in training is higher for better prepared workers, the firm will invest more time in training. This relationship is depicted in figure 4.1.

In figure 4.1, two curves, P_1P_1 and P_2P_2, describe the relationship between on-the-job training and productivity. Curve P_1P_1 corresponds to worker 1 with less work experience, and curve P_2P_2 corresponds to worker 2 with more work experience. OC is the cost of training measured in terms of the unit of output. Note that with the same amount of on-the-job training, worker 2 is more productive than worker 1, and so, to attain the same skill level, worker 2 requires less on-the-job training. Also, the firm's optimizing behavior implies that the investment level is determined so that the net return from the investment is maximized. In figure 4.1, the optimal investment level for worker 1 is OT, and the optimal investment for worker 2 is OT_2 at which point the slope of the curves coincides with the slope of the cost curve. This model predicts that those

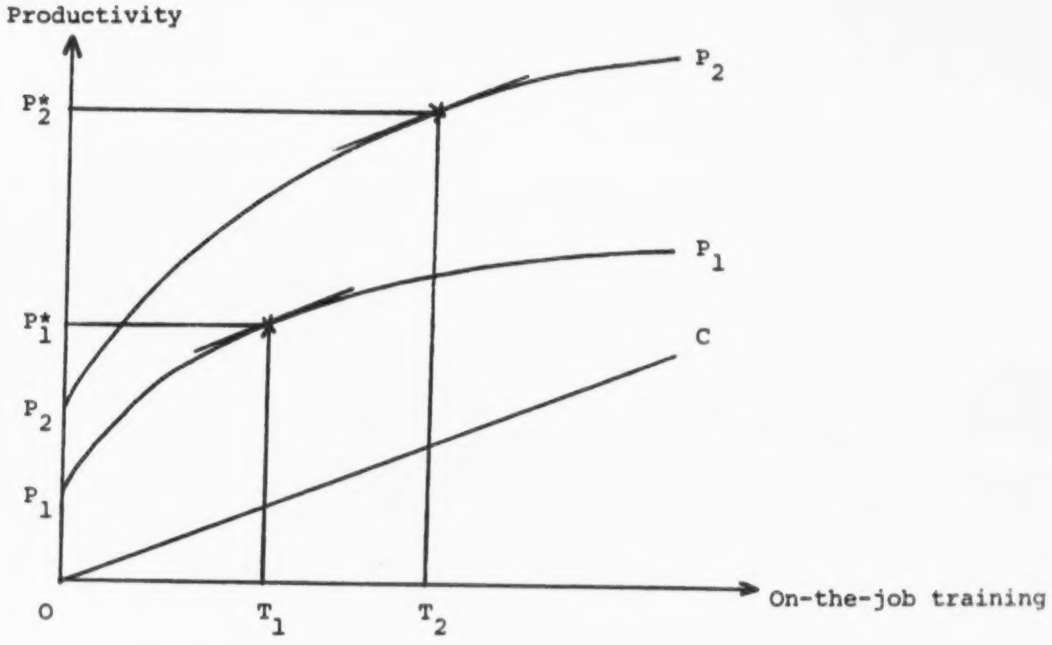
Productivity
P_2^*
P_1^*
P_2
P_1
O
T_1
T_2
On-the-job training
P_2
P_1
C

Figure 4.1 Productivity and on-the-job training--model 1

with more work-related experience receive more on-the-job training and are more productive than those without or with less work experience. Thus, the simple model in figure 4.1 may explain the observed pattern of productivity, training, and the work experience. We call the relationship shown in figure 4.1 model 1.

In the second type of relationship, on-the-job training can substitute for previous training. This is illustrated in figure 4.2. The relationship between training and productivity is given by the curve PP. The horizontal axis is total training expressed as the sum of previous training and on-the-job training. Productivity is a function of the sum of the two types of training. In figure 4.2, the worker's initial productivity is P_0, which corresponds to the level of previous training T_0. The worker's productivity increases with on-the-job training. Given the cost of on-the-job training depicted by the curve originating from T_0, the optimal level of on-the-job training is T_0T^*, because at T^* the difference between the productivity curve and the cost of on-the-job training is maximized. If this relationship is true, the firm will invest less in on-the-job training for those workers with more experience and will invest more in training for those workers with less experience. We call the relationship shown in figure 4.2, model 2.

In order to illustrate the difference between model 2 and model 1, we present figure 4.3 in which the horizontal axis is the amount of on-the-job training, the curve P_2P_2 is the productivity of the better prepared worker, and the curve P_1P_1 is the productivity of the less prepared worker. Given the cost of on-the-job training, the better prepared worker receives on-the-job training in the amount of OT_2, and the less prepared worker receives on-the-job training in the amount of OT_1. This model predicts that those who received more previous training require less training on the job to achieve a certain skill level and receive less on-the-job training than those with less previous experience. Furthermore, after the training period is completed, all the workers with the same characteristics except on-the-job training will attain the same skill (productivity) level.

In the third model, the productivity can be decomposed into two parts: one depends only on the previous experience, and the other is determined by on-the-job training. The productivity after the training period is determined by the sum of the two. This relationship is depicted in figure 4.4. Here,

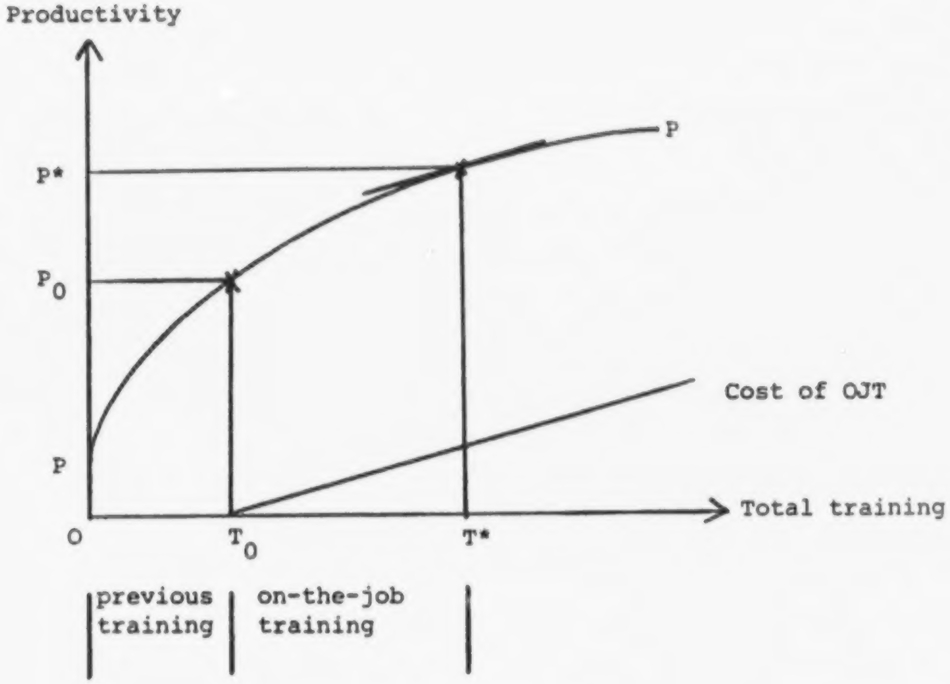
Productivity
P*
P_0
P
P
Cost of OJT
Total training
O
T_0
T*
previous training
on-the-job training

Figure 4.2 Productivity and total training--model 2

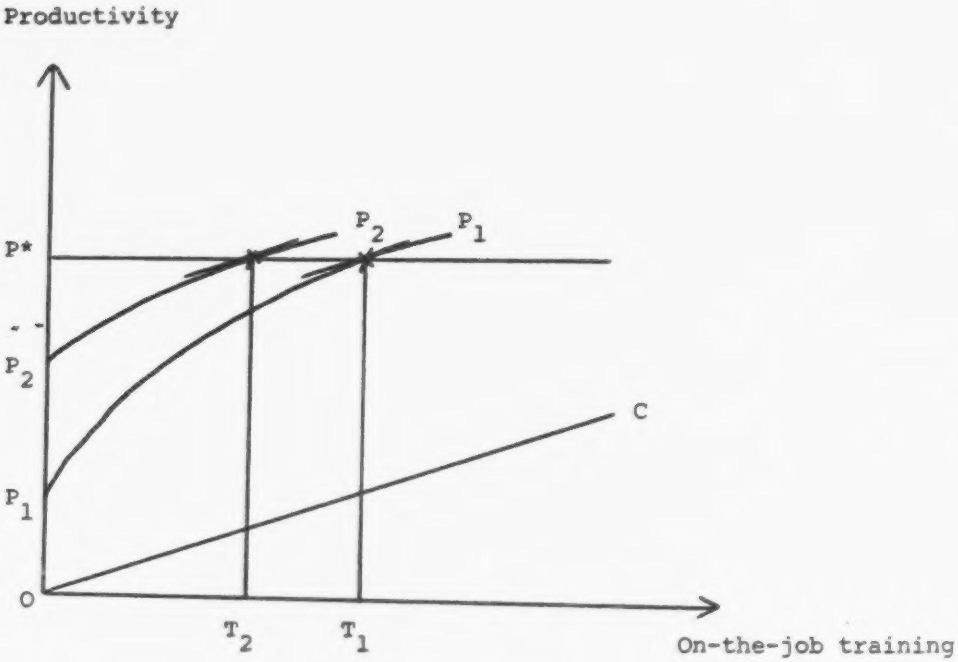
Productivity
P*
P2
P1
P2
P1
C
O
T2
T1
On-the-job training

Figure 4.3 Productivity and on-the-job training--model 2

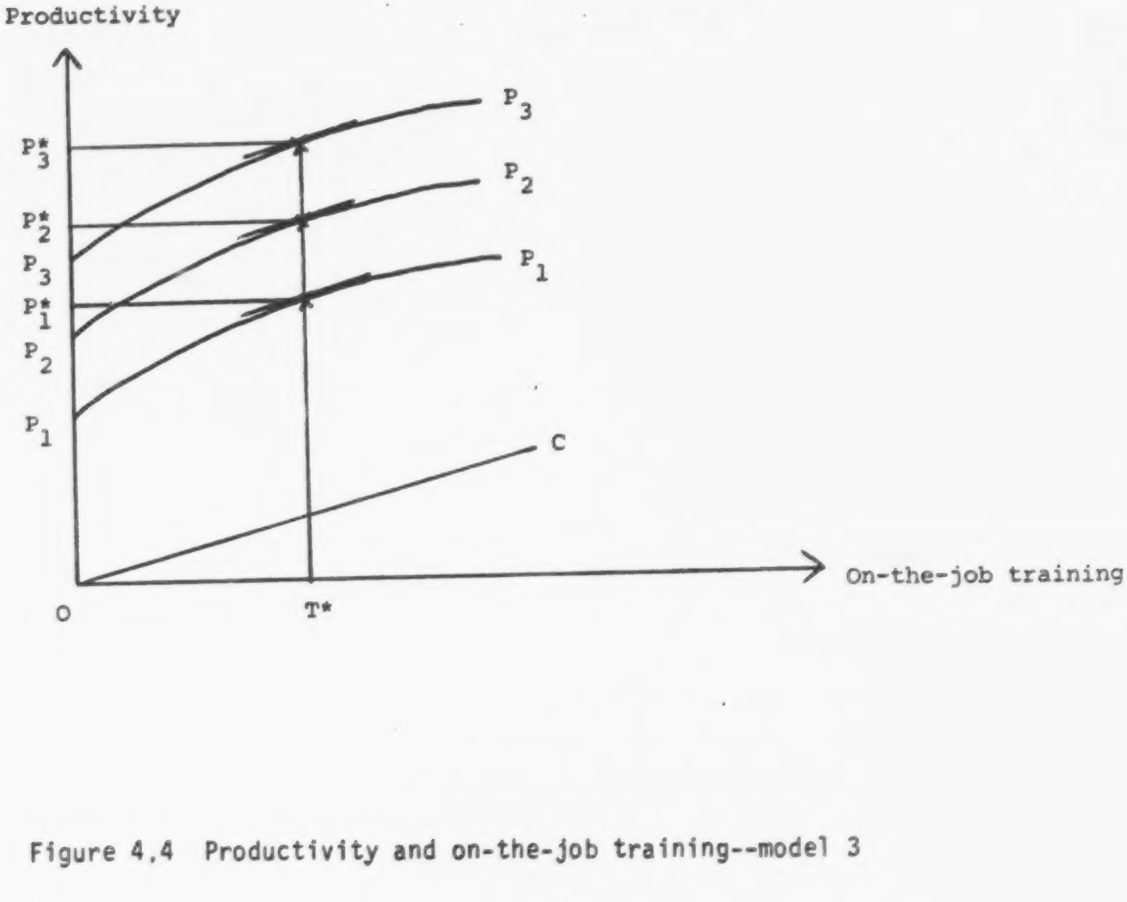

Figure 4.4 Productivity and on-the-job training--model 3

the effect of on-the-job training on the improvement of productivity does not depend upon the amount of previous training. Productivity of workers with more experience is higher than for those workers with less preparation. In figure 4.4, the curves P_1P_1, P_2P_2, and P_3P_3 are parallel to each other. The curve P_3P_3 corresponds to the worker with the best previous experience, P_2P_2 corresponds to the next best, and P_1P_1 corresponds to the least prepared worker. This model predicts that on-the-job training is determined independently from previous work experience and that all workers receive the same amount of on-the-job training. We call the relationship depicted in figure 4.4 model 3.

In testing the prediction from these three models, we shall look at the three variables determined by worker, job, and firm characteristics. They are productivity in the first 3 weeks on the job, starting wage rate, amount of on-the-job training, and productivity in the 3d-12th weeks of employment. In addition to these three variables, we also examine the determination of starting wage that influences the net return from training to the firm providing training. The firm's objective function is written as

$$(1) \qquad \max_{T,W} \; F(T, X_1, W) - C(T, X_2, W)$$

where F is the gross return from on-the-job training, which is determined by the amount of on the job training, turnover rate, worker's previous education, work experience, and vocational education, along with other job- and firm-specific characteristics. The argument T denotes the amount of on-the-job training, and X_1 is the vector of the other worker and job and firm characteristics that influence gross return from on-the-job training. Function C represents the sum of the direct and indirect cost associated with on-the-job training. X_2 includes the factors that influence the opportunity cost of the training investment, such as the presence of an experienced training staff in the firm and the operation rate, which influence the opportunity cost of training incurred by the instructors and trainees.

W is the wage rate during the training period and enters into both gross return function F and the cost function C. The wage rate affects the gross return and the cost of training through two channels. The higher the wage, the lower the worker-initiated labor turnover. This effect increases the gross return from the training investment. The opportunity cost of training, on the other hand, increases with wage rate. The total effect is determined by the relative magnitude of these two effects. The firm will try to maximize the difference between gross return from on-the-job training, F, and the cost of on-the-job training, C, by choosing the level of on-the-job training and the starting wage rate. We assume that the firm determines the starting wage rate from the worker's observed characteristics and job and firm characteristics. Then, the equation for the starting wage is written as the function of worker characteristics X_w, job characteristics X_j, and firm characteristics X_f.

(2) $W = X_w a_w + X_j a_j + X_f a_f$.

The amount of on-the-job training, on the other hand, may depend not only on the worker's characteristics and job and firm characteristics observed prior to employment. The firm has an option to adjust the training plan after observing a new hire's performance within the first 2 weeks on the job. We propose two alternative specifications for the determination of on-the-job training. If the firm's training decision is based entirely on the information available prior to employment, the equation for on-the-job training is written as (3).

(3) $T = X_w b_w + X_j b_j + X_f b_f$.

Alternatively, if the firm adjusts the training plan after observing the new hire's performance, the equation for on-the-job training is given by (4).

(4) $T = dP_0 + X_w b'_w + X_j b'_j + X_f b'_f$

where P_0 denotes the initial productivity of the worker. Observed positive or negative association between on-the-job training and initial productivity then signals the underlying relationship between on-the-job training and productivity growth. If model 1 is true, we expect that the coefficient for the initial productivity d to be positive. If model 2 is true, d will be negative, and if model 3 applies, d will be zero.

Also, the initial productivity of the worker without previous training in the firm is written as (5).

(5) $P_0 = X_w c_w + X_j c_j + X_f c_f$.

The relationship between on-the-job training and worker productivity after the training period in the general form is written as

$$P_1 = G(P_o, T, X_w, X_j, X_f)$$

where P_1 is the productivity after the training period. The most simple formulation of the relationship between P_1 and the explanatory variables is the linear form in (6).

$$(6) \quad P_1 = d_oP_o + d_tT + X_wd_w + X_jd_j + X_fd_f$$

The parameter for the initial productivity d_o is the depreciation factor, and the parameters d_t, d_w, d_j, and d_f are the marginal effects of on-the-job training, the worker characteristics, the job characteristics, and the firm characteristics on productivity, respectively.

Linear form in (6), however, does not allow for the interaction between initial productivity and on-the-job training.

In order to test the implications from models 1 through 3, and also for the sake of parsimony of parameters in the model, the equation is specified in the following form:

$$(7) \quad P_1 = e_oP_o + e_1(P_o \times T) + e_TT + X_we_w + X_je_j + X_fe_f$$

The second term is the interaction between the initial productivity and training. This specification allows the marginal return from the training to be dependent upon the level of initial productivity. Model 1 predicts a positive coefficient on the transaction term; model 2 predicts the coefficient to be negative, and if model 3 is true, the transaction term will have a zero coefficient.

4.3 Data

An index of the firm's training input in the first 3 months (12 weeks) of employment is created by Bishop (1982). The index is defined as the weighted sum of the four forms of the training, time devoted to (1) watching others do the job, (2) formal training program conducted by management, (3) informal training conducted by management, and (4) informal training conducted by coworkers. Time spent in these four activities is given weights that are determined by the opportunity cost associated with these activities and aggregated into scaler value.[1] The index can be interpreted as the total person-hours of skilled worker devoted to the training activity. The worker's productivity index is obtained from the following question:

> Please rate your employee on a productivity scale of 0-100, where 100 equals the maximum productivity rating new employees can attain and 0 is absolutely no productivity rating by new employees.

The employers gave their evaluation of new hires' productivity for the first 2 weeks, for the next 10 weeks, and for the date of interview, or if the worker had left the firm, the productivity score at the date of departure. Since data on the amount of training after the first 12 weeks were not collected and the date on which the most recent productivity scores were evaluated differed by firms, the third productivity score is not a reliable source for measuring the effect of on-the-job training. Therefore, we looked at the first two scores of productivity that were measured in the same time interval across samples. It should be noted, however, that by their construction, reported productivity scores, in a strict sense, are not comparable across firms. This is because the best worker whose productivity score is 100 in 1 firm may not be as productive as the best worker in another firm. Thus, the productivity score given to the new hire, which is measured relative to a hypothetical best worker's productivity, does not represent his or her productivity in other firms. However, it may be reasonable to assume that once the occupation is specified, the best worker in one firm is also the best worker in the same occupation in another firm. Although we cannot be completely free from the measurement problem, this assumption allows us to estimate the productivity gain as a function of on-the-job training and other worker, job, and firm characteristics.

The classifications of the occupational groups are the following: (1) clerical; (2) sales, excluding retail occupations; (3) service, (4) retail; (5) crafts; and (6) management.

The explanatory variables included in the estimation are classified into three groups: worker characteristics, job characteristics, and firm characteristics. The worker characteristics variables are years of education, including both formal academic and vocational education; relevant work experience for the current job measured in months; years of vocational education related to the current job; age at the time of hiring; and sex.

The job characteristics variables include a measure of the generality of skill multiplied by local labor market size, reflecting the degree of potential demand for the worker after the training is completed;[2] the training requirement expressed as the number of weeks to become fully trained if the worker did not have any previous job-specific training; an index of the importance of specific vocational preparation required for the job based on the five-digit DOT codes for the job; the log of the value of the machine used in the job; two dummies for the mode of compensation--one for piece rate and the other for partial incentive; a dummy for a temporary job; and the number of weekly work hours.

Firm characteristic variables are the log of the establishment size, ratio of new hires to the establishment's employment size, quit rate of new hires, the rate of sales growth, and the variable that takes a value of sales growth when it is positive or that is zero otherwise. Sales growth variables reflect the opportunity cost of training and the expected returns from the training investment. When the firm's sales are expanding, the opportunity cost of training will be higher, and when sales are declining, the expected monetary return from training will be lower. But, the cost of training is also low, so we expect that the relationship between firm growth and on-the-job training is not monotonic. In addition to the worker, job, and firm characteristics, four dummies for industries, construction, mining and manufacturing, wholesale and trade, and finance and service are included in the list of explanatory variables.

The descriptive statistics are presented in table 4.1. In the top panel, note that a positive association exists between the amount of training and the starting wage across occupations. Higher paying occupations, such as management and crafts, tend to offer more training. Service occupations, which are regarded as low-skill jobs, pay the lowest average wage, and the training index is about one-half of the index for managerial occupation. Also, skill requirement (number of weeks to become fully trained) in the second row of the third column and the training index show close positive association. Thus, occupations with higher skill requirements tend to invest more intensively in the early period of employment.

TABLE 4.1

DESCRIPTIVE STATISTICS[1]

Variable	Clerical		Sales		Service		Retail		Crafts		Management	
Starting Wage	4.23	(1.06)	4.37	(2.06)	3.52	(0.96)	4.36	(2.11)	5.71	(2.59)	6.94	(3.73)
Productivity First 2 Weeks	46.87	(25.65)	48.18	(27.07)	57.24	(24.24)	49.74	(26.45)	50.12	(26.11)	51.24	(30.54)
Productivity for 3d-12th Weeks	64.82	(21.81)	64.58	(21.29)	71.13	(18.34)	64.61	(21.17)	64.54	(20.16)	65.28	(24.97)
Training Index	154.23	(152.06)	152.81	(160.59)	103.86	(136.76)	153.28	(161.04)	178.75	(181.05)	213.23	(203.97)
Worker Characteristics												
Education (in years)	12.68	(1.34)	12.51	(1.62)	12.05	(1.40)	12.49	(1.65)	12.17	(1.32)	13.85	(1.90)
Relevant work experience (in months)	3.53	(3.30)	3.44	(2.74)	3.51	(3.60)	3.44	(2.60)	4.93	(5.58)	4.75	(4.42)
Vocational education (in years)	0.53	(0.87)	0.40	(0.82)	0.35	(0.71)	0.38	(0.80)	0.71	(1.02)	0.59	(0.98)
Age	26.75	(8.49)	26.12	(9.82)	26.07	(9.82)	25.95	(9.24)	26.74	(8.49)	29.14	(9.76)
Sex (female = 1, male =0)	0.90	(0.30)	0.49	(0.50)	0.57	(0.49)	0.48	(0.50)	0.11	(0.32)	0.35	(0.48)
Job Characteristics												
Gen. of skill times labor market size	5.66	(3.66)	4.35	(3.40)	4.07	(3.37)	4.23	(3.37)	4.59	(3.31)	4.73	(3.17)
No. of weeks to become fully trained	13.58	(20.59)	14.94	(22.81)	8.68	(17.33)	15.34	(23.60)	32.23	(38.37)	26.86	(34.35)
Imp. of spec. voc. training	4.15	(1.56)	3.44	(1.57)	3.37	(1.67)	3.41	(1.55)	6.33	(1.31)	7.06	(1.07)
Log of the value of machine	1.47	(1.41)	1.14	(1.33)	1.06	(1.17)	1.12	(1.34)	2.36	(1.86)	1.81	(1.75)
Piece rate	0.005	(0.067)	0.045	(0.208)	0.034	(0.182)	0.039	(0.197)	0.044	(0.208)	0.031	(.174)
Partial incentive	0.02	(0.16)	0.12	(0.32)	0.13	(0.34)	0.11	(0.31)	0.06	(0.25)	0.18	(0.38)
Job temporary	0.09	(0.29)	0.19	(0.40)	0.17	(0.38)	0.20	(0.40)	0.11	(0.31)	0.09	(0.29)
Weekly hours worked	37.08	(6.68)	34.31	(9.75)	32.24	(10.70)	34.19	(9.90)	39.36	(6.50)	40.74	(8.52)
Firm Characteristics												
Log employment size	3.06	(1.50)	2.45	(1.15)	3.22	(1.26)	2.43	(1.13)	2.92	(1.43)	2.78	(1.57)
Log employment size squared	11.62	(10.76)	7.34	(7.84)	11.94	(9.23)	7.22	(7.80)	10.54	(11.10)	10.21	(11.71)
Ratio of new hire to employment	26.41	(25.18)	30.73	(26.91)	35.21	(27.78)	30.90	(27.11)	31.93	(28.52)	29.17	(25.94)
Quit rate of new hires	30.01	(27.25)	32.95	(28.27)	34.47	(25.43)	33.55	(29.06)	32.75	(26.83)	30.27	(25.77)
Rate of sales growth	7.39	(27.48)	5.34	(28.33)	2.94	(14.70)	4.55	(28.70)	1.74	(20.80)	1.33	(20.07)
Positive growth rate of sales	10.42	(24.74)	9.11	(25.25)	6.28	(10.21)	8.53	(25.55)	7.33	(15.34)	7.55	(13.86)

NOTE: Standard deviations is in parentheses.

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For crafts and management occupations, the numbers of weeks to become fully trained are more than twice the period in which information on the training investment are available, so it is expected that a substantial amount of investment in training took place after 12 weeks of employment in these 2 occupational groups. Since there exists a certain time lag between the training investment and the realization of its return (improvement in productivity), we cannot expect reported productivity in 3-12 weeks of employment to be an accurate representation of the return from the training investment, especially in crafts and management occupations. Rather, an observed relationship between productivity and training in these data is a "snapshot" of a dynamic process in which the result of investment is being materialized.[3]

4.4 Estimation Results

Determination of On-the-Job Training

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The index of training is regressed on the initial productivity and various worker, job, and firm characteristics. Estimation results are presented in table 4.2. Estimated coefficients of the initial productivities have negative signs and are highly significant in five out of the six occupational groups. This result implies that the employer adjusted the level of on-the-job training after observing the worker's performance on-the-job in the first 2 weeks of employment. Negative coefficients on the initial productivities suggest that given occupation and worker characteristics, employers invest less intensively in training if new hires are more productive in the first 2 weeks of employment. The result is in favor of model 2 which predicts that on-the-job training is a substitute for previous job preparation. The magnitudes of the coefficients reflect the sensitivity of on-the-job training with respect to the change in initial productivity. The (absolute) magnitudes of the coefficients are in the following descending order: retail, sales, crafts, clerical, service, and management occupations. In terms of elasticity, when evaluated at the sample mean values, 1 percent increase in the initial productivity reduces on-the-job training by 0.79 percent in retail, 0.69 percent in sales, 0.55 percent in service, 0.52 percent in crafts, 0.36 percent in clerical, and 0.21 percent in management occupations.

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TABLE 4.2

INDEX OF ON-THE-JOB TRAINING[1] BY OCCUPATION

Variable	Clerical		Sales		Service		Retail		Crafts		Management	
Productivity First 2 Weeks	-1.065***	(0.312)	-2.204***	(0.390)	-1.000***	(0.341)	-2.445***	(0.404)	-1.853***	(0.506)	-0.874	(0.752)
Worker Characteristics												
Education	4.053	(5.897)	-5.620	(5.875)	15.633***	(6.176)	-4.651	(5.856)	9.536	(9.600)	1.662	(12.676)
Relevant work experience (in months)	6.164*	(4.080)	8.162	(7.111)	7.239*	(4.638)	5.832	(7.549)	-4.436	(6.396)	6.382	(13.794)
[2]Relevant work experience squared	-31.477***	(15.282)	-57.842	(46.982)	-15.950	(13.535)	-24.427	(53.567)	7.665	(18.795)	0.584	(64.392)
Vocational education (in years)	9.106	(9.162)	-0.936	(13.268)	30.896***	(13.354)	4.742	(13.481)	3.606	(14.099)	-10.487	(23.532)
Age	1.031	(0.987)	-0.628	(1.125)	-2.568***	(0.906)	-1.231	(1.159)	-1.486	(2.064)	-4.410*	(3.001)
Female	-23.526	(24.836)	29.433*	(21.273)	18.120	(17.741)	30.153*	(21.939)	-4.981	(42.434)	11.773	(53.730)
Job characteristics												
Gen. of skill times labor market size	-2.445	(2.046)	1.389	(2.818)	5.669***	(2.486)	0.919	(2.841)	4.117	(4.008)	-5.277	(7.479)
No. of weeks to become fully trained	2.306***	(0.388)	1.570***	(0.376)	0.607*	(0.463)	0.952***	(0.411)	0.795***	(0.363)	-0.357	(0.789)
Imp. of specfic voc. training	1.695	(4.929)	2.065	(6.375)	1.055	(5.403)	-0.468	(6.486)	-6.641	(10.146)	-0.274	(18.445)
Log value of machine	6.336	(5.781)	-1.244	(7.835)	6.568	(7.071)	1.984	(8.200)	7.534	(7.797)	-2.913	(14.120)
Piece rate	-26.720	(104.822)	-4.443	(40.389)	-80.451**	(42.509)	19.885	(44.488)	35.410	(60.631)	50.208	(155.894)
Partial incentive	-32.805	(55.931)	-2.135	(32.039)	-29.676	(25.725)	-18.562	(33.204)	7.645	(51.795)	96.697*	(62.092)
Temporary job	14.494	(27.912)	-20.416	(26.140)	-35.992*	(23.599)	-22.809	(25.767)	43.698	(44.573)	59.762	(94.017)
Weekly hours worked	1.205	(1.168)	2.620***	(1.158)	1.803***	(0.834)	2.061**	(1.203)	-0.168	(2.146)	-0.936	(3.495)
Firm Characteristics												
Log estab. size	-33.722*	(22.082)	-46.646**	(25.525)	-41.303*	(26.039)	-58.895***	(26.408)	9.884	(33.780)	-49.421	(59.086)
Log estab. size squared	6.028***	(3.061)	6.745**	(3.663)	4.101	(3.627)	8.531***	(3.709)	-1.561	(4.436)	11.716*	(8.056)
Ratio of new hires	-0.284	(0.300)	0.119	(0.382)	0.218	(0.306)	-0.006	(0.385)	0.223	(0.468)	-2.313***	(1.035)
Quit rate of new hires	0.725***	(0.309)	0.419	(0.364)	0.346	(0.331)	0.432	(0.331)	0.790	(0.520)	0.523*	(0.952)
Growth rate of sales	-0.787	(0.937)	0.624	(1.014)	0.404	(1.025)	-0.760	(0.996)	1.415	(1.277)	-2.930	(2.551)
Positive growth rate of sales	0.703	(1.011)	0.148	(1.121)	-1.384	(1.446)	0.157	(1.097)	-0.915	(1.740)	7.612***	(3.541)
Number of observations	382		255		250		228		201		99	
R squared	0.221		0.340		0.241		0.315		0.192		0.247	

Standard errors are in parentheses
Entries are the coefficients multiplied by 100

* Significant at the 20% level (two-sided)
** Significant at the 10% level (two-sided)
*** Significant at the 5% level (two-sided)

Effects of the three job-related preparations--education, work experience, and vocational education--are mostly small and statistically insignificant except in service occupations. In service occupations, those workers with more academic education and vocational education tend to receive more intensive training. This result is somewhat puzzling because, in general, the skill requirement in service occupations is low and more educated workers require less training to become fully trained.

A plausible explanation of this phenomena is that within service occupations, those workers with better preparation tend to get the jobs with better promotion opportunity and also get more training. Service occupations in the early period of employment for the better educated workers may be the first step to higher level jobs in the later stages of their careers.

The measure of skill requirement--number of weeks to become fully trained--has significant positive coefficients in five out of six occupational groups. Hence, not only across occupational groups, but also within the same occupational groups, jobs that require more training tend to invest more intensively in on-the-job training in the early period of employment. One exception is management for which the point estimate is negative and insignificant. One reason that may explain this result is the following: The number of weeks to become fully trained in the managerial occupations is on the average 27 weeks, which is more than twice the period for which training input data are obtained. Skill requirements for management are more complex than for other occupational groups. Some examples of managerial skills are motivation of subordinates, cooperation with fellow managers, and organization the work schedule. We expect that improvement of these skills requires a great deal of learning by doing. Thus, training investment tends to occur over the longer period, and its intensity is less sensitive to the total skill requirement.

Other noticeable results in the training index regressions are insignificant or positive and significant coefficients on the female dummies and the effects of establishment size. In their studies of Current Population Surveys of adult education, Meyerson, Zemsky, Tierney, and Berg (1983) found that women received less formal on-the-job training than their male counterparts from 1969 to the late 1970s, but the gender gap tends to disappear after 1980. Our

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estimation result coincides with their observation when work training is measured as the sum of both formal and informal training.

In five out of six occupational groups, the coefficients for the log of the establishment size have negative signs for their linear term and positive signs for their quadratic terms, implying that the training investment is larger either in small firms or large firms but smaller in medium-sized firms. This result, however, does not apply to crafts occupations.

Determination of Initial Productivity and Starting Wage

Initial Productivity. The estimation results for inital productivity are presented in table 4.3. Overall, the variations in productivity are not well explained by the worker and firm characteristics included in the model. R squares are low and range from 0.10 to 0.23. Across the six occupational groups, the variables representing worker characteristics and firm characteristics seem to have no consistent significant effects on the determination of productivity measure in the first 2 weeks of employment.

Job characteristics variables, on the other hand, show some significant effects, especially in those representing skill requirement. Significant effects are found in the number of months needed to become fully trained, which should have close relationship with the new hire's productivity relative to the best worker in the firm. As expected, the estimated coefficients have negative signs and except in the service occupation they are highly significant. Also, the other variable that represents the skill requirement--index of importance of specific vocational training shows significant negative effects in clerical and crafts occupations. Skill requirements in these two occupations are well defined compared to the other four occupations and directly affect productivity from the very beginning of employment. Clerical workers' productivity may be easily judged by typing speed and accuracy. The skills of crafts workers, for example, an auto mechanic's knowledge of mechanical and electrical systems of various automobiles, affect their productivity from the very start of employment. On the other hand, in the four other occupational groups productivity in the first 1 or 2 weeks largely depends on knowledge and familiarity with the operation in the workplace rather than specific skills.

TABLE 4.3

PRODUCTIVITY FIRST 2 WEEKS[1]

Variable	Clerical		Sales		Service		Retail		Crafts		Management	
Worker Characteristics												
Education (in years)	-0.320	(0.862)	-0.427	(0.877)	2.926***	(1.080)	-0.028	(0.907)	0.554	(1.204)	-3.183**	(1.602)
Relevant work experience (in months)	0.712	(0.636)	0.841	(1.048)	1.041*	(0.775)	0.651	(1.137)	1.678***	(0.767)	2.203	(1.847)
[2]Relevant work experience squared	-2.224	(2.507)	-3.842	(6.779)	-3.521*	(2.375)	2.638	(7.670)	-4.201**	(2.372)	-7.097	(8.836)
Vocational education (in years)	1.582	(1.316)	-0.338	(1.773)	1.335	(1.984)	-0.292	(1.822)	-1.225	(1.509)	-1.532	(2.909)
Age	0.139	(0.150)	0.309**	(0.163)	0.083	(0.154)	0.194	(0.171)	0.600***	(0.244)	0.148	(0.382)
Female	-2.247	(3.718)	-4.405	(3.085)	-1.162	(2.978)	-5.519**	(3.281)	-4.079	(4.908)	-4.285	(7.154)
Job Characteristics												
Gen. of skill x local labor market size	-0.144	(0.310)	0.565	(0.418)	-0.207	(0.432)	0.611*	(0.437)	0.110	(0.480)	0.698	(0.932)
No. of mo. to become fully trained	-0.150***	(0.057)	-0.224***	(0.059)	-0.062	(0.085)	-0.239***	(0.066)	-0.113***	(0.043)	-0.190**	(0.097)
Imp. of spec. voc. training	-1.087*	(0.757)	-0.265	(0.930)	-0.831	(0.890)	-0.727	(0.977)	-2.512***	(1.226)	-1.966	(2.350)
Log of machine value	-2.470***	(0.850)	-1.556*	(1.185)	-1.019	(1.204)	-1.551	(1.268)	1.004	(0.993)	-1.391	(1.910)
Piece rate	2.213	(18.199)	-5.853	(6.169)	-15.147***	(7.402)	3.598	(7.165)	-4.598	(7.936)	5.668	(18.977)
Partial incentive	13.111**	(7.507)	-8.205**	(4.534)	-8.984***	(4.284)	-8.892**	(4.821)	11.716**	(6.689)	0.006	(7.181)
Job is temporary	-1.723	(4.201)	8.809**	(3.720)	-5.762*	(3.901)	8.589***	(3.786)	-0.545	(5.178)	18.362**	(10.443)
Work hours	0.082	(0.180)	-0.147	(0.164)	-0.300***	(0.138)	-0.270*	(0.174)	-0.158	(0.258)	0.088	(0.407)
Firm Characteristics												
Log employment size	-6.388***	(3.251)	-2.847	(3.849)	4.030	(4.006)	-4.955	(4.066)	-3.914	(4.032)	-4.915	(7.782)
Log employment size squared	0.610*	(0.449)	0.321	(0.575)	-0.495	(0.547)	0.492	(0.597)	0.286	(0.516)	0.514	(1.069)
Ratio of new hires	0.009	(0.046)	0.085*	(0.056)	-0.126***	(0.051)	0.032	(0.058)	-0.023	(0.059)	0.057	(0.123)
Quit rate of new hires	0.045	(0.044)	0.052	(0.051)	-0.052	(0.055)	0.068*	(0.052)	0.121**	(0.063)	-0.155*	(0.113)
Sales growth	-0.085	(0.126)	-0.119	(0.146)	-0.199	(0.170)	0.171	(0.146)	0.072	(0.149)	0.426	(0.324)
Positive sales growth	-0.160	(0.140)	-0.163	(0.164)	0.141	(0.245)	-0.191	(0.165)	-0.087	(0.206)	-0.580	(0.463)
Number of observations	515		344		311		309		262		128	
R squared	0.097		0.204		0.142		0.189		0.217		0.232	

Standard errors are in parentheses.
Entries are the coefficients multiplied by 100

* Significant at the 20% level (two sided)
** Significant at the 10% level (two sided)
*** Significant at the 5% level (two sided)

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From these results, we may conclude that the productivity indices in the first 2 weeks on the job are mainly determined by the skill requirement of the job. This is because of the construction of the productivity measure employed in the data. Also, there is a great deal of idiosyncratic noise not captured by the explanatory variables included in the model.

Starting wage. The estimation results of the starting wage rate equation are presented in table 4.4. Unlike initial productivity, variations within the occupational groups have significant associations with the variables included in the model, and estimated coefficients show some variation across occupations.

The marginal effects of years of education on starting wage are positive in all the occupational groups and their magnitudes are about the same in clerical, sales, service, and retail. One year of formal education increased starting wage by 11 to 14 cents per hour in these occupations. However, a craftsworkers starting wage is insensitive to education, and the return to a year of schooling shows the highest value in management (82 cents per hour), which is substantially larger than ones in other occupations in both absolute and relative magnitudes. Effects of the work experience are also positive across occupations when evaluated at the sample mean values. The marginal returns from work experience show decreasing pattern in service, crafts, and management, but the quadratic term is insignificant in clerical and sales, and on increasing pattern is observed in retail.

The coefficients for vocational education can be interpreted as the premiums on vocational education over academic education, because the education is measured as the sum of academic and vocational education. Except for clerical workers, the premiums are negative. That is, those who received vocational education instead of academic education received lower wage rates.

Age and sex also have significant effects on starting wage. Age has a positive effect on wage, even after controlling for education and work experience, which may reflect the maturity of the worker and a higher reservation wage. Female workers receive substantially lower wages than males, even in female dominant clerical occupations in which the wage gap shows the smallest value (35 cents per hour) among the six occupational groups. The wage

TABLE 4.4

STARTING WAGE[1]

	Clerical		Sales		Service		Retail		Crafts		Management	
Worker Characteristics												
Education (in years)	0.1256***	(0.0366)	0.1155***	(.0582)	0.1430***	(0.0360)	0.1438***	(0.0601)	0.0135	(0.1078)	0.8225***	(0.1763)
Relevant work experience (in months)	0.0155	(0.0257)	0.0921*	(.0629)	0.0658***	(0.0272)	-0.0588	(0.0775)	0.1301***	(0.0693)	0.4792***	(0.2121)
[2]Relevant work experience squared	-0.0697	(0.1047)	0.2137	(.3564)	-0.1485**	(0.0836)	1.9414***	(0.5605)	-0.4645***	(0.2190)	-2.5259***	(1.1137)
Vocational education (in years)	0.0814*	(0.0557)	-0.1523*	(.1129)	-0.0274	(0.0704)	-0.1845***	(0.1210)	-0.0629***	(0.1388)	-0.2361	(0.298)
Age	0.0218***	(0.0060)	0.0206***	(.0104)	0.0193***	(0.0056)	0.0157	(0.0110)	0.0809***	(0.0217)	0.0614**	(0.038)
Female	-0.3487***	(0.1504)	-0.7899***	(.2023)	-0.4382***	(0.1056)	-0.8374***	(0.2174)	-1.1207***	(0.4501)	-2.0114***	(0.7529)
Job Characteristics												
Gen. of skill times labor market size	0.0552***	(0.0127)	0.0285	(.0269)	0.0111	(0.0152)	0.0444**	(0.0282)	-0.0053***	(0.0428)	0.0775	(0.0989)
No. of mo. to become fully trained	0.0026	(0.0024)	0.0075**	(.0043)	0.0098***	(0.0031)	0.0062	(0.0043)	0.0077	(0.0039)	0.0040	(0.0111)
Imp. of specialized vocational training	0.0165	(0.0310)	0.2520***	(.0598)	0.0235	(0.0318)	0.2385***	(0.0639)	0.0400	(0.1105)	0.0604	(0.3080)
Log value of machine	0.0205	(0.0354)	0.0285	(.0804)	-0.0418	(0.0426)	0.0288	(0.0860)	0.2174***	(0.0890)	0.3671**	(0.1930)
Piece rate	-0.5517	(0.7099)	2.0284***	(.4679)	-0.0309	(0.2899)	2.0636***	(0.5242)	1.6509**	(0.6797)	-0.6282	(1.8225)
Partical incentive	0.0602	(0.3039)	0.7374***	(.2997)	-0.1956	(0.1558)	0.3815	(0.3338)	1.0593*	(0.5967)	0.3780	(0.8026)
Job is temporary	-0.1013	(0.1678)	-0.2584	(.2360)	-0.1596	(0.1360)	-0.2802	(0.2422)	-0.6692*	(0.4659)	-0.8220	(1.1671)
Weekly work hours	0.0080	(0.0075)	0.0275***	(.0108)	0.0025	(0.0048)	0.0235***	(0.0113)	0.0358	(0.0234)	0.0040	(0.0437)
Firm Characteristics												
Log employment size	0.2297**	(0.1313)	0.5022***	(.2448)	0.4657***	(0.1433)	0.4433**	(0.2585)	0.2694	(0.3636)	-0.1801	(0.7779)
Log employment size squared	-0.0262*	(0.0180)	-0.0618**	(.0363)	-0.0588***	(0.0194)	-0.0535*	(0.0380)	-0.0099	(0.0462)	0.0754	(0.1059)
Ratio of new hires	0.0016	(0.0019)	0.0121**	(.0035)	0.0004	(0.0018)	0.0102***	(0.0037)	-0.0030**	(0.0053)	0.0084	(0.0129)
Quit rate of new hires	-0.0031**	(0.0018)	-0.0024	(.0034)	0.0013	(0.0020)	-0.0011	(0.0034)	-0.0107	(0.0055)	-0.0157*	(0.0122)
Sales growth	0.0098**	(0.0055)	.0058	(.0094)	-0.0006	(0.0063)	0.0064	(0.0095)	-0.0014	(0.0139)	-0.0162	(0.0326)
Positive sales growth	-0.0101**	(0.0061)	.0002	(.0105)	0.0045	(0.0089)	0.0000	(0.0107)	0.0151	(0.0188)	-0.0090	(0.0464)
Number of observations	466		318		301		289		257		104	
R Squared	0.261		0.465		0.323		0.486		0.358		0.562	

Standard errors are in parentheses.
Entries are the coefficients multiplied by 100

* Significant at the 20% level (two-sided)
** Significant at the 10% level (two-sided)
*** Significant at the 5% level (two-sided)

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gaps between male and female are larger in all other occupations even after controlling for work hours and temporary work status. The wage rate gap is largest in management occupations in which the difference in the hourly wage rate is about $2.00 and the next largest gap is found in crafts occupations ($1.12 per hour).

Improvement in Productivity

Improvement in productivity from the first 2 weeks to the next 10 weeks is determined by the amount of on-the-job training, the initial level of productivity, and other worker, job, and firm characteristics. The simplest formulation is to regress worker productivity scores in the 3rd-12th weeks on the initial productivity, an index of on-the-job training, and other control variables. The coefficient for the initial productivity in this formulation may be interpreted as the depreciation factor for the initial productivity. Since the interval between the time at which these productivities are measured is very short, we expect that depreciation should be negligibly small. Estimated coefficients for initial productivity in this formulation, however, lie between 0.7 and 0.5, which is rather too low to be interpreted as a depreciation factor, and the coefficient for the amount of on-the-job training is insignificant.[4] Possible explanations of this puzzling result are as follows:

- The marginal returns from on-the-job training may vary depending on the level of the initial productivity. Also, there may be interactions between training investment and the other explanatory variables.
- There may be errors in the measures of the initial productivity, which tend to yield downward biases in the estimated coefficients.[5]

In order to cope with the first problem, the model is estimated by imposing the restriction that the depreciation of the initial productivity is zero and by allowing interaction between the initial productivity and on-the-job training.[6] The estimation results are presented in table 4.5. In all the occupational groups, estimated coefficients for both the interaction term and training index are highly significant. The coefficient estimates for the interaction terms are all negative, and training indices have positive coefficients, indicating that the marginal returns from on-the-job training are

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TABLE 4.5

IMPROVEMENT IN PRODUCTIVITY[1]

Variable	Clerical	Sales	Service	Retail	Crafts	Management
Worker Characteristics						
Productivity in first 2 weeks times training index (divided by 10,000)	-7.280*** (0.955)	-7.638*** (1.531)	-14.072*** (2.272)	-7.972*** (1.695)	-6.364*** (1.149)	-6.959*** (1.947)
Training index (in years)	0.039*** (0.006)	0.043*** (0.007)	0.092*** (0.013)	0.046*** (0.007)	0.031*** (0.007)	0.026*** (0.013)
Education (in years)	0.375 (0.518)	0.597 (0.569)	0.081 (0.771)	0.279 (0.568)	0.458 (0.626)	0.172 (0.956)
Relevant work experience (in months)	-0.149 (0.358)	-0.468 (0.693)	0.472 (0.594)	0.257 (0.732)	-0.633* (0.423)	-0.112 (1.062)
[2]Relevant work experience squared	1.182 (1.343)	10.793*** (4.580)	-0.955 (1.712)	0.756 (5.196)	0.970 (1.237)	4.139 (4.906)
Vocational education (in years)	-1.144* (0.803)	-0.490 (1.309)	-2.097 (1.726)	-0.196 (1.338)	0.647 (0.928)	1.997 (1.820)
Age	-0.121* (0.086)	-0.356*** (0.109)	-0.024 (0.114)	-0.243*** (0.113)	0.171 (0.134)	-0.151 (0.235)
Female	5.757*** (2.213)	-0.292 (2.072)	-0.660 (2.215)	0.657 (2.138)	0.980 (2.761)	-2.416 (4.228)
Job Characteristics						
Gen. of skill times labor market size	-0.090 (0.180)	-0.047 (0.271)	0.236 (0.314)	-0.199 (0.273)	-0.211 (0.262)	-0.636 (0.576)
No. of weeks to become trained	-0.091*** (0.036)	-0.192*** (0.039)	-0.118*** (0.058)	-0.115*** (0.041)	0.012 (0.024)	-0.015 (0.060)
Imp. of specialized vocational training	-0.320 (0.432)	-0.602 (0.615)	-0.377 (0.683)	-0.547 (0.627)	-0.075 (0.662)	0.346 (1.405)
Log value of machine	1.194 (0.506)	-0.120 (0.757)	-0.560 (0.882)	0.096 (0.792)	-0.133 (0.509)	0.083 (1.091)
Piece rate	-4.829 (9.167)	2.783 (3.869)	9.976** (5.301)	-2.279 (4.287)	3.071 (3.950)	-6.382 (11.878)
Partial incentive	6.526 (4.894)	1.111 (3.096)	5.246** (3.207)	1.640 (3.200)	0.480 (3.410)	0.417 (5.034)
Job is temporary	4.017** (2.445)	-4.543 (2.489)	-0.478 (2.921)	-3.526* (2.468)	2.313 (2.906)	-4.147 (7.210)
Weekly work hours	-0.157** (0.103)	-0.006 (0.113)	0.020 (0.104)	0.042 (0.117)	0.044 (0.140)	0.150 (0.268)
Firm Characteristics						
Log employment size	4.434*** (1.946)	1.422 (2.748)	4.804** (3.289)	4.450** (2.573)	0.763 (2.211)	0.709 (4.509)
Log employment size squared	-0.495** (0.270)	-0.144 (0.355)	-0.397 (0.457)	-0.458* (0.361)	-0.054 (0.290)	-0.011 (0.618)
Ratio of new hires	0.043* (2.645)	-0.087 (0.037)	0.018 (0.038)	-0.060** (0.037)	-0.063*** (0.031)	-0.066 (0.085)
Quit rate of new hires	-0.034 (0.027)	-0.078 (0.035)	0.015 (0.041)	-0.071** (0.035)	0.014 (0.034)	0.070 (0.075)
Sales growth	0.265*** (0.082)	-0.002 (0.098)	0.064 (0.127)	-0.022 (0.096)	0.064 (0.083)	-0.026 (0.195)
Positive sales growth	0.260*** (0.088)	0.034 (0.108)	0.081 (0.181)	0.058 (0.106)	0.026 (0.113)	0.255 (0.277)
Number of observations	380	251	245	225	200	97
R Squared	0.261	0.292	0.245	0.275	0.281	0.305

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[1] Standard errors are in parentheses.

[2] Entries are the coefficients multiplied by 100

* Significant at the 20% level (two-sided)

** Significant at the 10% level (two-sided)

*** Significant at the 5% level (two-sided)

higher if the initial level of productivity is low and the marginal return from on-the-job training decreases as the initial productivity becomes higher. This result is consistent with the predicition from model 2 presented in the theory section. It seems that the estimation results of the training index and improvement in productivity equation both indicate that the underlying relationship between on-the-job training and productivity is better described by model 2.

Marginal Return from Training

Table 4.6 shows the estimates of the marginal return from on-the-job training on productivity improvement by the initial productivity level. The occupational group with the highest return from training is service, and the magnitudes of the marginal return in the other occupations are in the following descending order: retail sales, clerical, crafts, and management. This order of marginal returns seems to coincide with the reverse order of the skill requirements in these occupational groups. This suggests that the marginal return from training measured in relative units is high in the occupations that require lower skills and low in the occupations that require higher skills.

A disturbing fact is that the calculated marginal returns in crafts and management occupations become negative at a rather low level of initial productivity--37 for managers and 50 for craftsworkers. The marginal return from training evaluated at the sample mean values is also negative for these two occupations. Since it is unlikely that more training lowers workers' productivity, these negative estimates of the marginal returns suggest that either the model's control variables do not fully capture the factors that influence return from training, or observed productivity gains in 3-12 weeks of employment are not an appropriate measure of return from training in these 2 occupations. The second explanation is more plausible than the first because the average required training period for these two occupational groups is much longer than the 12 weeks for which productivity is reported--average number of weeks to become fully trained are 32 weeks for craftsworkers and 27 weeks for managers; whereas for other occupations, the average is 8-16 weeks. Since the realization of training investment benefits takes time, the productivity observed between 3-12 weeks of employment is a rather poor measure of the return. It seems that in order to estimate the return from training more

TABLE 4.6

MARGINAL RETURN FROM ON-THE-JOB TRAINING BY INITIAL PRODUCTIVITY

Initial Productivity	Clerical	Sales	Service	Retail	Crafts-Worker	Management
20	0.024	0.027	0.064	0.030	0.018	0.012
30	0.017	0.020	0.050	0.022	0.012	0.005
40	0.010	0.012	0.036	0.014	0.005	-0.002
50	0.003	0.005	0.022	0.006	-0.001	-0.009
60	-0.004	-0.002	0.008	-0.008	-0.009	-0.009
At mean (Mean)	0.005 (48.87)	0.004 (48.18)	0.007 (57.24)	0.006 (49.74)	-0.001 (50.12)	-0.009 (51.24)

NOTE: The marginal return to on-the-job training on the improvement in productivity is given by $e_0P_0 + e_t$, where P_0 is the index of initial productivity, e_0 is the coefficient for the transaction term of initial productivity and training, and e_t is the coefficient for training. See equation (6). The marginal returns are calculated for various levels of initial productivity.

accurately for these two occupations, we need to obtain the data on training input and productivity scores for a longer time span.

The coefficients on other worker characteristics--academic education, work experience, and vocational education prior to starting work--can be interpreted as the effects of previous job-related preparation on productivity improvement that do not depend on on-the-job training, such as learning by doing. The estimated coefficients on academic education are all positive, but none of them are significantly different from zero. The marginal effects of work experience, when evaluated at the sample mean values, are also positive, but the estimated coefficients are not significantly different from zero except for the squared term in sales. The estimates for vocational education are negative in clerical, sales, service, and retail occupations, and they are positive in crafts and management occupations, but again they are statistically insignificant.

Other noticeable patterns are the following. Among job characteristic variables, the number of weeks to become fully trained has negative coefficients in the four low-skill occupations (clerical, sales, service, and retail), and they are highly significant in clerical and sales occupations. These findings, however, should be interpreted as the reflection of the construction of productivity scores data. The log establishment size variables have a positive sign in linear terms and negative sign in quadratic terms. Their marginal effects on improvement in productivity, evaluated at the sample mean values, are positive. Also, across all the occupational groups, the highest marginal returns are achieved at the higher end of establishment size distribution. Thus, improvement in productivity is faster in larger firms. This may be suggesting that on-the-job training is more efficient in the larger establishments.

Premium on Vocational Education

From the estimates of the starting wage, initial productivity, and improvement in productivity equation, we calculated the relative impact of vocational education on these three measures. Table 4.7 presents the premiums on vocational education based on the point estimates of the three equations.

Wage and productivity premiums on 1 year of vocational training are obtained from the following calculations. When 1 year of academic education is

TABLE 4.7

STARTING WAGE AND PRODUCTIVITY PREMIUM ON ONE YEAR OF VOCATIONAL EDUCATION

Occupation	Difference in wage rate (in dollars)	Difference in productivity index (first 2 weeks)	Difference in productivity index (3 to 12 weeks)
Clerical	0.081 (1.9%)	1.582 (3.4%)	0.260 (0.4%)
Sales	-0.152 (-3.5%)	-0.338 (-0.7%)	-0.789 (-1.2%)
Service	-0.027 (-0.7%)	1.335 (2.3%)	-0.957 (-1.3%)
Retail	-0.185 (-4.2%)	-0.292 (-0.6%)	-0.452 (-0.7%)
Crafts	-0.063 (-1.1%)	-1.225 (-2.4%)	-0.438 (-0.7%)
Management	-0.236 (-3.4%)	-1.532 (-3.0%)	0.692 (1.1%)

replaced by the same amount of vocational education, the predicted changes in wage rate and initial productivity are the estimated coefficients for vocational education in the wage and initial productivity equations. In the table, entries in the first and second columns are the estimates of these coefficients. The impact of vocational education on productivity during the 3d-12th weeks of employment is the sum of the two effects. The first is the change in the initial productivity, which also affects the marginal return from training through the equation's interaction term for improvement in the productivity. The second effect is the linear term in the improvement in the productivity equation. Holding the total training at the sample mean values, the total premium of vocational education's effect on productivity in 3-12 weeks of employment is the sum of these 2 effects. In table 4.7, the productivity premium in the 3d-12th weeks is calculated by using the sample mean values of the training index and other worker, job, and firm characteristics. Except for clerical workers, the premiums on the starting wage are negative. Their magnitudes are 8.1 cents (1.9) for clerical, -15.2 cents (-3.5) for sales, -2.7 cents (-0.7) for service, -18.5 cents (-4.2) for retail, -6.3 cents (-1.1) for crafts, and -23.6 cents (-3.4) for management occuapations. These numbers suggest that, in sales, retail, and management occupations, taking vocational education instead of academic education results in a 3-4 percent lower starting wage.

The corresponding productivity indices for the first 2 weeks, however, do not show as much disadvantage as the wage rates. The initial productivity is higher in clerical (3.4 percent) and service (2.3 percent) occupations, and except for crafts occupations, relative disadvantage in productivity is less than wage rate differentials.

The differences in productivity due to vocational education tend to diminish in the next 10 weeks across all the occupational groups, and the largest difference is only (minus) 1.3 percent in service occupations.

These observations indicate that those workers who received 1 year of vocational training instead of academic education tend to receive lower starting wages, but the differences in productivities are negligibly small across 5 occupational categories in the first 12 weeks on the job. One exception is the clerical occupation. Clerical workers who took 1 year of relevant vocational training instead of academic education tend to receive 1.9 percent higher starting wage rate and are more productive in the beginning by 3 percent. This advantage in productivity, however, becomes negligible after 3 months of employment. If this relationship between the productivity of vocationally trained workers and workers with no vocational education persists in the subsequent work periods, employers benefit from hiring vocationally trained workers.

4.5 Conclusion

This study examined the impact of on-the-job training on improving productivity in the early period of employment. In order to see the productivity change in a comparable unit and to identify the differential effects of on-the-job training by occupation, the relationship is examined for six separate occupational groups. In the theory section, the three competing models of the effect of on-the-job training on the initial productivity and improvement in productivity are presented. The first model asserts that new hires with better job preparation have a higher return from on-the-job training and that the previous work-related preparations and on-the-job training are complements. The prediction from this model is that those with higher initial productivity receive more training on-the-job, improve their productivity faster than the those with less preparation (lower initial productivity), and show a higher marginal return from on the job training.

The second model asserts that the previous work-related preparations and on-the-job training are substitutes and that work-related experience, academic education, vocational education, and work experience can be replaced by on-the-job training. This model predicts that those with higher initial productivity receive less training, and improvement in their productivity relative to cost of training is lower; in other words, the marginal return from on-the-job training is lower.

The third model assumes that given worker, job, and firm characteristics, the improvement in productivity depends only on the amount of on-the-job training. This model predicts that new hires receive the same amount of on-the-job training regardless of their initial level of productivity, and that the improvement in productivity does not depend on the initial productivity.

Analysis of the National Employer Survey data supports the predictions of the second model, when occupations are held constant and improvement in productivity is measured in the first 12 weeks of employment. This relationship between the initial skill level and the return from on-the-job training is strong in the low-skill occupations--clerical, sales, service, and retail--but weak in crafts and management occupations. The main source of this relationship, however, seems to be in the time period in which the productivity indices are reported. The difficulty of measuring the effects of on-the-job training is that the training is a continuous process, and the realization of return from training (i.e., improvement in productivity) occurs with certain time lags.

The reported required training periods in crafts and management occupations are more than twice the period in which productivity scores and on-the-job training indices are measured. Thus, observed on-the-job training indices are not reflecting the employers' "desired" amount of training, and improvement in productivity in 12 weeks is not the full return from the training investment. This limitation on the measurement, however, is less serious in the four other occupational groups for which the average required training periods are shorter than, or a little longer than, 12 weeks.

NOTES

1. A training time index was constructed from the data on time spent in the four types of training in the first months of employment by weighting them according to their opportunity costs. The management staff members who provided formal and informal training were assumed to be paid 1.5 times the wage of a co-worker, and the trainee's time was valued as equal to 0.8 hour of co-worker training time. When supervisors and co-workers are giving informal training to a new employee, the trainee is almost invariably involved in a production activity. Employers report that for informal training, the trainees are typically as productive while being trained as they are when working alone. Consequently, informal training is assumed to involve only the investment of the trainer's time. The training time index is equal to 0.8 times hours spent watching others do the job, plus 1.8 times the hours spent in formal training plus 1.5 times the hours spent in training conducted by management, plus hours spent in training conducted by co-workers.

2. The variable is defined as the proportion of skills learned on the job that are useful in other employment opportunities multiplied by the log of local labor market size.

3. The difficulty of measuring the return from the training investment is that realization of the return is a continuous process. Without specifying the explicit link between the timing of investment and its realization, the rate of return from training cannot be inferred from the observed data.

Rosen (1982) examined the relationship between wage and on-the-job training; he addressed this issue in the following statement: "The major obstacle to empirical analysis of OJT is that one cannot observe its rate of return even ex-post. It can be inferred from the shape of the age-earning profile, but this requires that one make specific assumptions on the nature of the process that generated the profile" (p. 443).

A theoretically satisfactory, yet highly restrictive relationship between training input and wage is suggested by Mincer (1974). The timing of the training and realization improvement in productivity, however, largely depends on the specific technology that varies by occupation and other job characteristics. It is difficult to establish the relationship between training and productivity analogous to Mincer's suggestion.

4. The estimation results are not included in the text.

5. In order to correct biases that might have been caused by the errors in variables, we need to have additional information on the structure of measurement errors or to use an instrument variable approach. If we estimate the model by assuming some measurement error structure on an ad hoc basis, the resulting estimates may be even worse. Although the instrument variable approach may solve the problem of bias, with a limited sample size and the fact that the variations in initial productivity are not explained well by the

variables included in the model, the use of the instrument variable will result in a substantial efficiency loss. The use of observed initial productivity in the estimation may be justified for the following two reasons: (1) by imposing the restriction that the depreciation of initial productivity is zero, one of the explanatory variables with errors in measurement is removed from the right-hand side; and (2) use of the proxy (reported initial productivity), rather than dropping it from the equation, will yield small asymptotic bias (McCallum 1972), and the estimates will have smaller mean square errors than the instrument variable estimates.

6. Another route by which previous job-related preparation can influence improvement in productivity is through the interactions with on-the-job training. However, the estimation results showed no significant effects of the interaction terms between training and work experience, schooling education, and vocational education.

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5.0 THE NATURE AND IMPACT OF TRAINING: EVIDENCE FROM THE CURRENT POPULATION SURVEY

Kevin Hollenbeck and Richard Willke

5.1 Introduction

A supplemental set of questions concerning prior training and training received on the job were posed to certain respondents of the January 1983 Current Population Survey (CPS). This supplement asked experienced workers whether they needed specific skills or training to obtain their current (last) job, and if so, whether they were obtained from a school, formal company training, informal on-the-job (OJT) experience, the armed forces, a correspondence course, relative or friends or informal training, or experience not related to work. In this chapter, we refer to the responses to these questions as qualifying training. These workers were also asked, "Since you obtained your present job, did you take any training to improve your skills? If so, how was that training received." Although no additional questions were asked of those reporting informal OJT, those who reported school-based or formal company training were asked to describe the training. For example, variables indicating type of school, whether employers paid for the training, whether the training was sponsored by a government program, length of the training, number of courses, and whether the training was completed were reported. The responses to this latter set of questions is referred to here as skill improvement training.

The U.S. Bureau of Labor Statistics (1985) presents a detailed tabular analysis of these data, particularly emphasizing the relationships between occupation and training. Some of the major findings presented in that study were the following:

- Among major occupational groups, the proportion of workers who needed qualifying training ranged from 93 percent in professional specialty occupations to 8 percent in private household occupations; the proportion who took skill improvement training ranged from 61 percent in professional specialty occupations to 3 percent in private household occupations.

- Of the 28.1 million workers who acquired their qualifying training through school programs, about 7.5 percent took training sponsored by employers, and 3 percent took training sponsored by the government in programs such as those offered under the Job Training Partnership Act (JTPA) and the Comprehensive Employment and Training Act (CETA).

- Forty-one percent of the 11.4 million workers who acquired skill improvement training in schools took training that was sponsored by employers; 3 percent of the workers who acquired skill improvement for their jobs obtained the training in government-sponsored school programs.
- Almost the same proportion of workers (10-11 percent) used training from formal company programs to qualify for jobs and to improve skills.
- Relatively few workers acquired qualifying training from correspondence courses, the Armed Forces, or friends and relatives.

This study examines the CPS data along other dimensions than those presented in the BLS study. But more importantly, it presents multivariate analyses of the determinants of training and the (earnings) payoff to training.

A number of limitations of the data must be borne in mind as the analytical results are considered. First of all, the data were collected from workers--for example, those that received the training--and not from employers.* As such, the data likely underestimate the extent of training because certain activities that are undertaken early in a worker's tenure may not be recognized as training, such as workplace orientations or job instructions. Furthermore, the worker may not be aware of specific skills or training that led to a job offer. Second, as with all surveys, the data depend on how the respondents interpret the questions. For example, with the question, "Did you need specific skills or training to obtain your current (last) job," some respondents may have changed jobs within the same occupation since leaving school or receiving their occupational training and, therefore, answered, "No," their job change was based on occupational experience, not specific skills or training. Some respondents may have focused on the word "specific" and answered "No" because their skills were general in nature. Some respondents may have excluded educational credentials from consideration.

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*Indeed, in about 20 percent of the cases, the data were collected from a family member other than the worker who received the training.

Similarly, the question, "Since you obtained your present job, did you take training to improve your skills," some respondents may have interpreted skills narrowly. For example, a word processor may have felt that he or she received training to learn new equipment, not to improve his or her skills. Some respondents may have received specific training in company policies or practices but felt that the training did not improve their skills.

Third, certain important features of the data cannot be clearly identified. For example, there is no information on when the training was received; nor is there a way to tell whether the training received on one's current job was entry-level or upgrading/retraining, or both. The distinctions drawn in the questionnaire do not correspond to the distinction between specific and general training. Training obtained prior to one's current job is likely to be mostly general, but the training obtained since taking one's current job could be either or both. Finally, little information on the quantity and nature of informal OJT is available, despite the fact that it accounts for about 80 percent of company training (Bishop 1982).

Despite these limitations, the large sample size, the nationwide representation, and the individual characteristics data allow analyses of the CPS supplemental data to be an important source of knowledge about training. In the next section, tabular analyses of the CPS data are presented. Section three describes the results of multivariate analyses of the determinants of prior job and skill improvement training. Finally, the effects of training on earnings are estimated for a subsample of the CPS supplement and results are reported in section four.

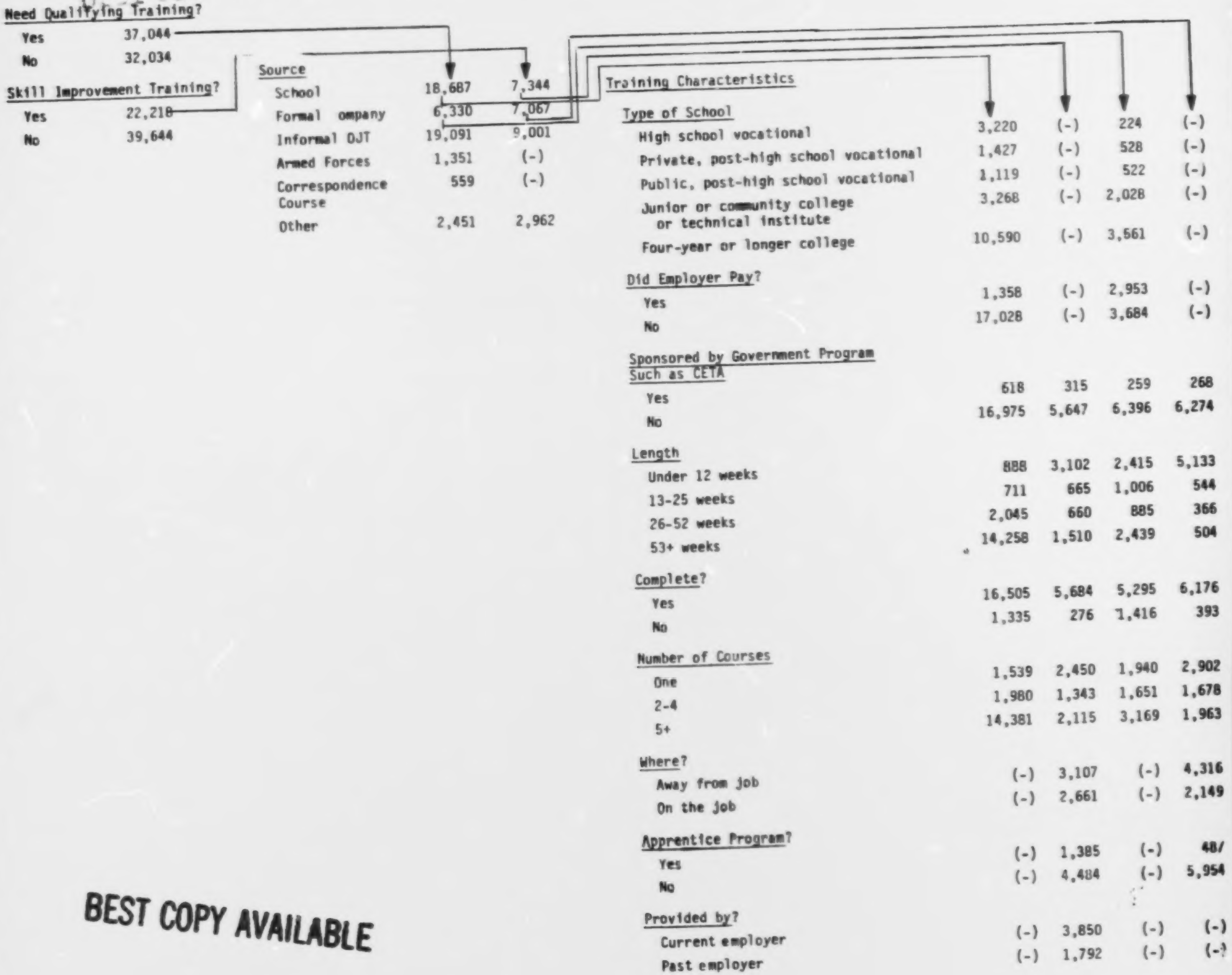
5.2 Descriptive Statistics about Training and Those Receiving Training

To gain a statistical "picture" of the CPS data, this section of the report presents a number of tabulations and cross tabulations of the training program information and characteristics of respondents. The section begins by first examining the aggregated training program detail as reported by respondents to the supplemental questions. It compares and contrasts details about qualifying and skill improvement training and compares and contrasts school-based and formal company training programs.

Next, the data for systematic relationships between individual characteristics and training likelihood and between individual characteristics and sources of training is examined. Indeed, a number of such relationships hold true in the data. In particular, age, race, occupation, education, and census region of residence are all found to be related to the likelihood of a worker reporting training. In addition to simple bivariate cross tabulations between training and individual characteristics, the chapter discusses the results of performing three-way analyses in which relationships between individual characteristics and training are examined while controlling for occupational variation. The final section analyzes the characteristics of individuals who reported school-based or formal company qualifying or skill improvement training.

Levels of Qualifying and Skill Improvement Training

Figures 5-1 and 5-2 present the unweighted and weighted aggregate data on sources and types of training from the CPS supplement. Using the data from figure 5-2, it can be seen that approximately 54 percent of the respondents indicated that they needed specific skills or training to obtain their job; about 35 percent indicated that they had taken skill improvement training. Among the sources of qualifying training, informal OJT and school were mentioned most often (cited as a source by 51 percent and 50 percent of the individuals who had needed qualifying training, respectively). The next most important source of qualifying training was formal company programs as was mentioned by 17.4 percent of the respondents who had needed qualifying training. Training received in the Armed Forces, from a correspondence course, or from informal, non-work related sources such as friends or relatives were relatively minor sources of qualifying training; in combination, they were only reported by about 11 percent of those with qualifying training. Individuals with qualifying training were instructed to mark all sources that applied to them. On average, each person who had needed training marked 1.30 sources (characteristics of people with multiple sources are analyzed as follows).



Need Qualifying Training?	
Yes	37,044
No	32,034

Skill Improvement Training?	
Yes	22,218
No	39,644

Source		
School	18,687	7,344
Formal company	6,330	7,067
Informal OJT	19,091	9,001
Armed Forces	1,351	(-)
Correspondence Course	559	(-)
Other	2,451	2,962

Training Characteristics				
Type of School				
High school vocational	3,220	(-)	224	(-)
Private, post-high school vocational	1,427	(-)	528	(-)
Public, post-high school vocational	1,119	(-)	522	(-)
Junior or community college or technical institute	3,268	(-)	2,028	(-)
Four-year or longer college	10,590	(-)	3,561	(-)
Did Employer Pay?				
Yes	1,358	(-)	2,953	(-)
No	17,028	(-)	3,684	(-)
Sponsored by Government Program Such as CETA				
Yes	618	315	259	268
No	16,975	5,647	6,396	6,274
Length				
Under 12 weeks	888	3,102	2,415	5,133
13-25 weeks	711	665	1,006	544
26-52 weeks	2,045	660	885	366
53+ weeks	14,258	1,510	2,439	504
Complete?				
Yes	16,505	5,684	5,295	6,176
No	1,335	276	1,416	393
Number of Courses				
One	1,539	2,450	1,940	2,902
2-4	1,980	1,343	1,651	1,678
5+	14,381	2,115	3,169	1,963
Where?				
Away from job	(-)	3,107	(-)	4,316
On the job	(-)	2,661	(-)	2,149
Apprentice Program?				
Yes	(-)	1,385	(-)	487
No	(-)	4,484	(-)	5,954
Provided by?				
Current employer	(-)	3,850	(-)	(-)
Past employer	(-)	1,792	(-)	(-)

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NOTE: (-) indicates question was not asked.

Figure 5-1. Unweighted responses to the January 1983 CPS training supplement.

Need Qualifying Training?	
Yes	58,177
No	50,252
Skill Improvement Training?	
Yes	33,917
No	62,258

Source		
School	29,291	11,461
Formal company	10,148	10,651
Informal OJT	29,744	13,625
Armed Forces	2,045	(-)
Correspondence course	806	(-)
Other	3,603	4,311

Training Characteristics				
Type of School				
High school vocational	5,067	(-)	373	(-)
Private, post-high school vocational	2,222	(-)	809	(-)
Public, post-high school vocational	1,684	(-)	777	(-)
Junior or community college or technical institute	5,219	(-)	3,300	(-)
Four-years or longer college	16,501	(-)	5,445	(-)
Did Employer Pay?				
Yes	2,178	(-)	4,580	(-)
No	26,636	(-)	5,770	(-)
Sponsored by Government Program Such as CETA?				
Yes	949	509	381	381
No	26,606	9,028	9,962	9,485
Length				
Under 12 weeks	1,348	4,941	3,594	7,685
13-15 weeks	1,112	1,078	1,560	828
26-52 weeks	3,160	1,064	1,396	555
53+ weeks	22,435	2,436	3,963	815
Complete?				
Yes	25,869	9,089	8,125	9,294
No	2,066	457	2,376	619
Number of Courses				
One	2,412	3,870	2,960	4,410
2-4	3,171	2,191	2,548	2,530
5+	22,471	3,405	5,019	2,943
Where?				
Away from job	(-)	5,137	(-)	6,476
On the job	(-)	4,249	(-)	3,277
Apprenticeship Program?				
Yes	(-)	2,241	(-)	728
No	(-)	7,172	(-)	8,976
Provided by				
Current employer	(-)	6,213	(-)	(-)
Past employer	(-)	2,871	(-)	(-)

NOTE: Entries in thousands (000s). (-) indicates question was not asked.

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Figure 5-2. Weighted responses to the January 1983 CPS training supplement

Among the respondents who indicated that they had received qualifying training in a school setting, following is the distribution of responses as to the type of school:

- High school vocational program--17.6%
- Private, post-high school vocational school--7.7
- Public, post-high school vocational school--5.8
- Junior or community college or tech. institute--18.0
- Four year or longer college program--57.0

Again respondents could mark multiple responses, but in this case, very few did--the average number of school settings for those that reported qualifying training in schools was 1.06. In terms of sponsorship of a school-based program of qualifying training, about 7.5 percent of the respondents indicated that their employers paid for the training and about 3.4 percent indicated that the training was sponsored by a government program such as CETA.

As would be expected by the large share of this training taken at four year or longer college programs, the training programs tended to be longer than 52 weeks (80 percent) and to involve 5+ courses (80 percent). About 93 percent of the respondents who got qualifying training in a school setting completed the training.

Qualifying training that was in a formal company training program was quite different from school-based qualifying training. It was much shorter--about 47 percent of the programs lasted under 12 weeks and only 23 percent lasted more than 52 weeks. It was comprised of fewer courses--approximately 41 percent was reported to be a single course whereas 36 percent of the formal company training had 5 or more courses. At 95 percent, the completion rate of formal company training was similar to that for school-based qualifying training. Most of this formal company training was provided by the respondents' current employer (68 percent) as opposed to a former employer, and the majority was off-site (55 percent). A sizable share of the formal company training was in an apprenticeship program leading to journeyperson status--23.6 percent.

The largest source of skill improvement training was reported to be informal OJT. This was reported by 40.5 percent of the respondents who had taken such training. Schools and formal company training were the next 2 largest sources, reported by 33 and 32 percent of the respondents, respectively. The residual "other" category was indicated by 13.3 percent of the skill improvement trainees. On average, each person who had taken skill improvement training marked 1.19 sources, a lower ratio than for qualifying training.

Among the respondents who indicated that they had taken skill improvement training since obtaining their present job, following is the distribution of responses as to the type of school setting:

- High school vocational program--3.2%
- Private, post-high school vocational program--7.7
- Public, post-high school vocational program--7.6
- Junior or community college of tech. institute--29.6
- Four-year or longer college program--51.9

The major differences between this percentage distribution and the same distribution for qualifying training in a school setting are a much lower incidence of skill improvement training in a high school vocational program and a lower incidence of training in a four-year or longer college program with the slack taken up by junior or community colleges or technical institutes. In terms of sponsorship of a school-based program for skill improvement training, about 3.9 percent of the respondents indicated that the training was sponsored by a government program such as CETA, and 44.5 percent indicated that their employers paid for the training. The latter is contrasted with only 7.5 percent of the respondents with school-based qualifying training who had had their employers pay for the training.

Since a larger share of the skill improvement training at schools occurred in junior or community colleges relative to qualifying training, and since employers paid for a large share of it, it would be expected that the training would be shorter and more focused. Indeed, as the distributions in table 5-1 show, this was the case. Over 50 percent of the skill improvement training in schools lasted less than half a year compared to less than 10 percent for qualifying training. About 30 percent of the skill improvement training in schools was comprised of one course compared to about 9 percent for school-based qualifying training. The completion rate for school-based skill improvement training was 78.9 percent, but it should be recognized that some respondents may have still been in the process of taking the training when they were interviewed.

TABLE 5-1

LENGTH AND NUMBER OF COURSES COMPRISING SCHOOL-BASED QUALIFYING AND SKILL IMPROVEMENT TRAINING

Length or Number of Courses	Percentage Distribution for Individuals with School-based Qualifying Training	Percentage Distribution for Individuals with School-based Skill Improvement Training
Under 12 weeks	5.0%	35.8%
13-25 weeks	4.0	14.9
26-52 weeks	11.4	13.1
53+ weeks	79.6	36.2
Courses		
One	8.6%	28.7%
2-4	11.1	24.4
5+	80.3	46.9

Skill improvement training in a formal company program was shorter than school-based skill improvement training--78 percent was completed in under 12 weeks compared to 36 percent. It was sponsored by a government program for 4.1 percent of the individuals with this kind of training, which is comparable to the 3.9 percent of individuals reporting school-based skill improvement training sponsored by government programs. The completion rate of formal company skill improvement training was 94.0 percent--much higher than the completion rate for school-based skill improvement training. Most of the formal company skill improvement training took place away from the job--66.8 percent. Finally, very little was apprenticeship training leading to journeyperson status--only 7.6 percent.

Characteristics of Individuals Who Reported Training

This section examines the characteristics of individuals who reported needing qualifying training or taking skill improvement training, or both. In addition it examines characteristics of individuals by sources of training. The primary characteristics examined are age, race, sex, educational attainment, occupation, industry, region, job tenure, and whether or not the respondent was engaged in the same work 1 year ago.

Age. Table 5-2 provides data on training by the (current) age of the worker. Interestingly, using any of a number of different ways of measuring likelihood of having been trained, there is a curvilinear relationship between age and that likelihood. The younger and older age classes have the lowest incidence of training and the relationship peaks in the 25-44 brackets. For example, almost 60 percent of individuals in the 25-34 and 35-44 age brackets reported qualifying training, whereas only about 22 percent of workers aged under 20 and about 40 percent of workers aged 20-24 or over 65 reported qualifying training. This relationship might be explained by poorer recall among older workers, but another explanation may be the increasing job complexity introduced by automation and technological advances during the last two decades.

TABLE 5-2

PERCENTAGE OF INDIVIDUALS IN THE EXPERIENCED LABOR FORCE WITH QUALIFYING OR SKILL IMPROVEMENT TRAINING BY AGE

Training Type	Age							
	Under 20	20-24	25-34	35-44	45-54	55-64	65+	Total
Total Experienced Labor Force	7,590	15,613	31,396	23,145	16,761	12,005	2,914	109,424
Qualifying Training								
Yes	22.4%	44.1	59.8	60.6	56.2	51.6	41.1	53.2%
No	77.1	55.0	39.6	38.5	42.6	47.3	57.8	46.0
Skill Improvement								
Yes	14.4%	23.7	34.6	37.0	34.1	28.9	17.9	31.0%
No	69.2	58.2	52.5	52.8	56.8	62.8	95.9	56.9
Not working	16.4	21.4	12.9	10.2	9.1	8.3	6.1	12.1
Qualifying or Skill Improvement								
Neither[a]	68.3%	46.2	31.7	30.8	35.2	41.0	55.2	38.3%
Qualifying only[a]	17.3	30.1	33.7	32.2	30.7	30.1	26.8	30.7
Skill improvement only	9.4	9.7	8.6	8.6	8.5	7.4	3.7	8.5
Both	5.0	14.0	26.1	28.4	25.6	21.5	14.0	22.5

NOTE: Counts of data are in thousands (000s). Column percents may not add to 100 because of missing data. Questions about skill improvement training were not administered to respondents who were not currently working.

[a] Includes respondents not currently working, so skill improvement training questions were not asked.

In table 5-3, the sources of qualifying training are displayed by age class. The percentages in the table are the share of individuals within the age class who reported needing qualifying training and that indicated receiving training from the sources listed on the left-hand side. The columns add to greater than 100 percent because many individuals took qualifying training from more than a single source. The ratio in the bottom row of the table represents the average number of sources of qualifying training reported for each age class. These ratios show that those with training who are age 25 reported the most sources of qualifying training; so not only do prime age individuals have the greatest likelihood of having received training, but they also have received the training from the most sources.

TABLE 5-3

PERCENTAGE DISTRIBUTION OF SOURCES OF QUALIFYING TRAINING BY AGE CLASS

Source	Age							
	Under 20	20-24	25-34	35-44	45-54	55-64	65+	Total
School	32.7%	50.5	54.8	51.7	47.4	44.9	44.2	50.4%
Formal Company Training	10.3	14.6	17.8	20.0	18.3	15.9	12.0	17.5
Informal OJT	57.7	50.0	49.6	50.1	53.4	54.2	53.9	51.2
Armed Forces	0.0	1.3	2.6	4.4	5.4	5.0	2.9	3.5
Correspondence Course	0.0	.5	1.0	1.8	2.1	1.9	1.3	1.4
Friend, Relative, Other	13.7	7.5	5.8	5.7	5.1	5.9	9.6	6.2
Ratio $\frac{\text{Sources}}{\text{Respondents}}$	1.149	1.243	1.317	1.278	1.336	1.336	1.241	1.300

NOTE: Column percents may add to greater than 100 because of multiple responses.

Figure 5-3 shows the relationships between sources of training and age of worker. School-based training and formal company training have the same curvilinear shape as the overall likelihood of training but informal OJT and training from friends, relatives, or other non-work-related sources have exactly the opposite slope. In general, school-based and formal company training are more expensive sources, and so, they may have the greatest productivity payoffs and returns to well-paid employees in their prime ages.

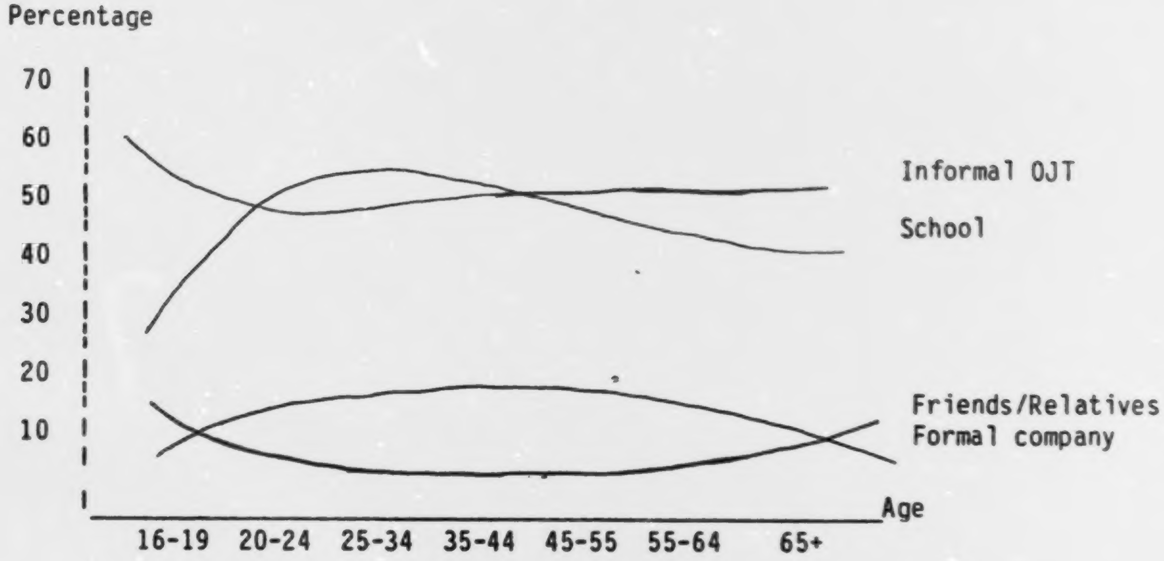

Figure 5-3. Sources of qualifying training by age

Race. Table 5-4 provides data on training by race--white, black, and other. The data show a clear pattern of whites reporting the highest likelihood of training and blacks the lowest. Whereas about 37 percent of whites reported neither qualifying nor skill improvement training, over 50 percent of blacks were in this situation. The other races had a training incidence that was in between whites and blacks but closer to the former than the latter.

In table 5-5, data on the sources of qualifying training are reported. Whites had a larger number of such sources than the other races with school and informal training on the job reported by about half of the respondents with training. Informal OJT was the largest source indicated by blacks, with schools a smaller share. This relationship was exactly opposite for the nonwhite and nonblack group, where schools were the largest source and informal OJT was significantly smaller.

Sex. There was not a substantial difference between males and females in terms of the likelihood of reporting either qualifying or skill improvement training or combinations of the two. As shown in table 5-6, about 53 percent of both sexes reported qualifying training and about 31 percent reported skill improvement training. The percentages with qualifying and/or skill improvement training are very similar as well.

TABLE 5-4

PERCENTAGE OF INDIVIDUALS IN THE EXPERIENCED LABOR FORCE WITH QUALIFYING OR SKILL IMPROVEMENT TRAINING BY RACE

Training Type	Race			Total
	White	Black	Other	
Total Experienced Labor Force	95,412	11,143	2,820	109,375
Qualifying Training				
Yes	54.7%	41.0	51.5	53.2%
No	44.5	57.8	47.6	46.0
Skill Improvement				
Yes	32.1%	22.7	28.1	31.0%
No	56.9	56.4	59.7	56.9
Not Working	11.0	20.9	12.2	12.1
Qualifying or Skill Improvement				
Neither[a]	36.8%	50.9	39.3	38.3%
Qualifying only[a]	31.1	26.4	32.6	30.7
Skill improvement only	8.5	14.5	9.2	8.5
Both	23.5	14.5	18.9	22.5

NOTE: Counts of data are in thousands (000s). Column percents may not add to 100 because of missing data. Questions about skill improvement training were not administered to respondents who were not currently working.

[a] Includes respondents not currently working, so skill improvement training questions were not asked.

TABLE 5-5

PERCENTAGE DISTRIBUTION OF SOURCES OF QUALIFYING TRAINING BY RACE

Source	Race			Total
	White	Black	Other	
School	50.8%	44.3	54.4	50.4%
Formal Company Training	17.4	18.9	15.5	17.5
Informal OJT	51.4	50.6	44.3	51.2
Armed Forces	3.6	3.3	2.8	3.5
Correspondence Course	1.4	.9	1.1	1.4
Friends, Relatives, Other	6.3	5.0	7.0	6.2
Ratio $\frac{\text{Source}}{\text{Respondents}}$	1.310	1.230	1.251	1.300

NOTE: Column percents may add to greater than 100 because of multiple responses.

TABLE 5-6

PERCENTAGE OF INDIVIDUALS IN THE EXPERIENCED LABOR FORCE WITH QUALIFYING OR SKILL IMPROVEMENT TRAINING BY SEX

Training Type	Sex Male	 Female	Total
Total Experienced Labor Force	61,726	47,653	109,379
Qualifying Training			
Yes	54.0%	52.2	53.2%
No	45.1	47.1	46.0
Skill Improvement			
Yes	31.2%	30.8	31.0%
No	55.7	58.5	56.9
Not working	13.1	10.7	12.1
Qualifying or Skill Improvement			
Neither[a]	37.6%	39.1	38.3%
Qualifying only[a]	31.2	30.1	30.7
Skill improvement only	8.4	8.7	8.5
Both	22.8	22.1	22.5

NOTE: Counts of data are in thousands (000s). Column percents may not add to 100 because of missing data. Questions about skill improvement training were not administered to respondents who were not currently working.

[a] Includes respondents not currently working, so skill improvement training questions were not asked.

Although the likelihood of reporting training did not differ substantially by gender, the sources of qualifying were quite different. Table 5-7 demonstrates that females reported fewer sources of training and the distribution by source is heavily skewed toward schools. Males, on the other hand, report higher incidences of training through informal OJT, formal company programs, in the Armed Forces, and from friends, relatives, and others.

Education. The data show a strong, positive relationship between educational attainment and training. Only about 28 percent of individuals with less than a high school diploma required training to obtain their jobs; about

50 percent of high school graduates needed training; over 60 percent of persons with some postsecondary education needed training; and almost 85 percent of individuals with 4 or more years of college reported needing qualifying training. As seen in table 5-7, the relationship between skill improvement training and education is similar.

TABLE 5-7

PERCENTAGE DISTRIBUTION OF SOURCES
OF QUALIFYING TRAINING BY SEX

Source	Sex		Total
	Male	Female	
School	44.3%	58.6	50.4%
Formal Company Training	20.0	14.0	17.5
Informal OJT	54.3	47.0	51.2
Armed Forces	5.9	.3	3.5
Correspondence Course	1.8	.8	1.4
Friend, Relative, Other	7.9	3.9	6.2
Ratio $\frac{\text{Source}}{\text{Respondents}}$	1.344	1.246	1.300

NOTE: Column percents may add to greater than 100 because of multiple responses.

As might be expected, table 5-9 shows considerable skewness toward school as a source of qualifying training for individuals with higher levels of educational attainment. Over 82 percent of individuals who had completed 4 or more years of college and who reported qualifying training reported school as a source of that qualifying training. About a third of these individuals reported informal OJT as a source of qualifying training. Contrast these 2 statistics with the sources of training for those individuals whose highest grade completed was less than 12. Here, only about 12 percent reported receiving their qualifying training in a school setting, while over 70 percent indicated that their qualifying training came from informal OJT.

Occupation. As with educational attainment, workers' occupations varied greatly with the likelihood of reporting qualifying or skill improvement training. Civilian workers were classified into seven major occupational groups for this analysis and are displayed along with workers in the Armed Forces in table 5-10. Workers in occupations classified as managerial, professional, and technical were most likely to report qualifying or skill improvement training. As table 5-11 shows, this training tended to be school

TABLE 5-8

PERCENTAGE OF INDIVIDUALS IN THE EXPERIENCED LABOR FORCE WITH QUALIFYING OR SKILL IMPROVEMENT TRAINING BY EDUCATION

Training Type	Education				Total
	Less than High school	High School	Some Post-Secondary	4 Years of College +	
Total Experienced Labor Force	22,347	44,295	20,512	22,246	109,400
Qualifying Training					
Yes	28.2%	47.1	60.8	83.5	53.2%
No	70.9	52.0	38.4	15.7	46.0
Skill Improvement Training					
Yes	13.4%	26.4	37.5	52.0	31.0%
No	68.5	60.3	52.3	42.8	56.9
Not working	18.1	13.3	10.2	5.3	12.1
Qualifying or Skill Improvement					
Neither[a]	64.3%	42.3	29.2	12.4	38.3%
Qualifying Only[a]	22.2	31.3	33.3	35.6	30.7
Skill Improvement Only	7.5	10.6	10.1	4.0	8.5
Both	6.0	15.8	27.4	47.9	22.5

NOTE: Counts of data are in thousands (000s). Column percents may not add to 100 because of missing data. Questions about skill improvement training were not administered to respondents who were not currently working.

[a] Includes respondents not currently working, so skill improvement training questions were not asked.

TABLE 5-9

PERCENTAGE DISTRIBUTION OF SOURCES OF QUALIFYING TRAINING BY EDUCATION

Source	Education				Total
	Less than High school	High School	Some Post-Secondary	4 Years of College +	
School	11.8	32.8	51.4	82.8	50.4%
Formal Company Training	14.6	20.4	20.7	13.0	17.4
Informal OJT	71.1	60.5	53.1	32.7	51.2
Armed Forces	2.4	4.2	5.1	2.0	3.5
Correspondence Course	.9	1.5	1.8	1.1	1.4
Friends, Relatives, Others	13.2	7.2	5.6	3.1	6.2
Ratio $\frac{\text{Sources}}{\text{Respondents}}$	1.140	1.266	1.376	1.348	1.300

NOTE: Column percents may add to greater than 100 because of multiple responses.

based. Clerical workers, crafts worker , and semiskilled workers had the next highest incidences of training, with each of these major occupational groups having about 50 percent of their workers reporting qualifying training and about 25 percent reporting skill improvement training. The sources of qualifying training were quite different for these two occupational groups, however. Clerical workers tended to get their training in schools, whereas the crafts and semiskilled occupations received training across a broader spectrum of sources with relatively more training occurring in formal company programs, informal OJT, and from friends, relatives, and others.

Sales workers had the next highest levels of training and sales as a sector was unique among the major occupations because of a relatively large proportion of skill improvement training. The ratio of the percentage of workers with skill improvement training to the percentage needing qualifying training is highest in sales. The percentage of workers with skill improvement training only is also highest in the sales occupational group. Service workers, unskilled laborer and agricultural workers, and Armed Forces personnel have relatively the least amount of training. Less than a third of these workers reported qualifying training and less than a fourth reported skill improvement training. In both categories, informal OJT was the highest mentioned source of qualifying training.

Industry. Substantial variation in the likelihood of training by industry of employment can be viewed in table 5-12. The service industries--FIRE (finance, insurance, and real estate), other private services, and government--had the highest levels of training among workers (around two-thirds had qualifying training). The mining and construction, TCPU (transportation, communications, and public utilities), and manufacturing sectors had the next highest levels (around half with qualifying training), and the trade and agriculture, forestry, and fishery sectors had the lowest levels (around one-third with qualifying training). Interestingly, the government sector had the highest level of training (in particular, skill improvement training) of all of the industrial sectors.

In terms of sources of qualifying training, table 5-13 shows that informal OJT was a source of qualifying training for about two-thirds of respondents with qualifying training in trade, mining and construction, and

TABLE 5-10

PERCENTAGE OF INDIVIDUALS IN THE EXPERIENCED LABOR FORCE WITH QUALIFYING OR SKILL IMPROVEMENT TRAINING BY MAJOR OCCUPATIONAL CLASSIFICATION

Training Type	Major Occupational Class								Total
	Managers Professional	Technical	Sales	Clerical	Service	Crafts, Semiskilled	Unskilled, Agr.	Armed Forces	
Total experienced Labor force	24,505	3,217	12,366	17,383	15,498	27,764	8,637	52	109,422
Qualifying Training									
Yes	82.3%	84.1	41.8	56.4	31.6	49.5	19.9	24.0	53.2%
No	17.0	15.1	57.3	42.6	67.8	49.5	79.4	72.3	46.0
Skill Improvement Training									
Yes	52.6%	49.4	29.0	29.6	20.7	23.3	12.0	(-)	31.0%
No	41.8	43.8	61.7	61.7	66.4	58.2	67.3	(-)	56.9
Not working	5.6	6.9	9.3	8.7	12.9	18.4	20.7	(-)	12.1
Qualifying and/or Skill Improvement									
Neither	12.5%	9.3	47.5	32.8	59.1	41.2	73.1	76.0	38.3%
Qualifying only	34.9	41.3	23.5	37.6	20.2	35.5	14.9	24.0	30.7
Skill Improvement only	5.2	6.5	10.8	10.8	9.3	9.3	7.0	(-)	8.5
Both	47.4	42.8	18.2	18.8	11.4	14.1	5.0	(-)	22.5

NOTE: Counts of data are in thousands (000s). Column percents may not add to 100 because of missing data. Questions about skill improvment training were not administered to respondents who were not currently working.

[a] Includes respondents not currently working, so skill improvement training questions were not asked.

TABLE 5-11

PERCENTAGE DISTRIBUTION OF SOURCES OF QUALIFYING TRAINING BY MAJOR OCCUPATIONAL CLASSIFICATION

Source	Major Occupational Class								Total
	Managers, Professional	Technical	Sales	Clerical	Service	Crafts, Semiskilled	Unskilled, Agr.	Armed Forces	
School	76.8%	68.1	32.9	57.2	35.1	19.3	20.3	29.8	50.4%
Formal Company Training	13.1	16.8	26.5	12.8	24.5	22.7	7.4	22.7	17.4
Informal OJT	36.3	37.4	65.3	54.3	51.5	66.2	67.4	36.2	51.2
Armed Forces	3.1	6.1	1.8	1.5	3.3	6.0	1.7	83.7	3.5
Correspondence Course	1.3	2.2	2.3	1.1	.5	1.6	.7	22.7	1.4
Friend, Relative, Other	3.5	1.9	6.8	2.2	6.1	11.1	26.2	0.0	6.2
Ratio $\frac{\text{Sources}}{\text{Respondents}}$	1.341	1.325	1.355	1.291	1.209	1.270	1.237	2.083	1.300

NOTE: Counts of data are in thousands (000s). Column percents may not add to 100 because of missing data. Questions about skill improvement training were not administered to respondents who were not currently working.

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TABLE 5-12

PERCENTAGE OF INDIVIDUALS IN THE EXPERIENCED LABOR FORCE WITH QUALIFYING OR SKILL IMPROVEMENT TRAINING BY MAJOR INDUSTRY

	Industry								
Training Type	Agriculture Forestry Fishery	Mining Construction	Manufacturing	TCPU[a]	Trade	FIRE[b]	Other Service	Government	Total
Total Experienced Labor Force	3,636	8,058	22,488	7,610	22,973	6,737	32,937	4,934	109,426
Qualifying Training									
Yes	31.0%	57.6	49.2	53.1	36.0	65.3	64.6	68.7	53.2%
No	68.0	41.7	49.9	45.7	63.2	33.7	34.7	30.3	46.0
Skill Improvement Training									
Yes	16.6%	20.0	27.0	34.7	21.2	44.4	53.8	54.0	31.0%
No	69.6	56.9	57.3	54.3	66.6	48.7	38.0	37.3	56.9
Not working	13.9	23.2	15.7	11.0	12.2	7.0	8.2	8.7	12.1
Qualifying or Skill Improvement									
Neither[c]	62.7%	36.2	41.4	34.7	54.3	24.0	29.4	19.0	38.3%
Qualifying only[c]	20.7	43.8	31.6	30.7	24.5	31.6	32.7	27.0	30.7
Skill Improvement only	6.3	6.2	9.4	12.2	9.7	10.7	6.0	12.4	8.5
Both	10.2	13.8	17.6	22.4	11.5	33.6	31.9	41.6	22.5

NOTE: Counts of data are in thousands (000s). Column percents may not add to 100 because of missing data. Questions about skill improvment training were not administered to respondents who were not currently working.

[a] TCPU--Transportation, Communication, and Public Utilities

[b] FIRE--Finance, Insurance, Real Estate

[c] --Includes respondents not currently working, so skill improvement training questions were not asked.

TABLE 5-13

PERCENTAGE DISTRIBUTION OF SOURCES OF QUALIFYING TRAINING BY MAJOR INDUSTRY

	Industry								
Source	Agriculture Forestry Fishery	Mining Construction	Manufacturing	TCPU[a]	Trade	FIRE[b]	Other Service	Government	Total
School	35.4%	27.7	41.4	31.6	30.4	52.0	70.8	57.5	50.4%
Formal Company Training	5.0	19.4	18.0	29.9	16.5	25.8	12.3	25.9	17.4
Informal OJT	58.7	66.2	61.3	55.2	68.8	54.0	35.2	44.1	51.2
Armed Forces	1.6	3.5	4.9	7.0	2.4	1.2	2.1	9.9	3.5
Correspondence Course	.9	1.6	1.4	2.1	1.2	2.3	1.0	2.0	1.4
Friend, Relative, Other	33.8	13.7	4.4	5.4	7.8	2.8	4.9	2.4	6.2
Ratio $\frac{\text{Sources}}{\text{Respondents}}$	1.354	1.322	1.314	1.312	1.272	1.380	1.264	1.417	1.300

NOTE: Column percents may add to greater than 100 because of multiple responses.

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manufacturing. It was mentioned only about 40 percent of the time in the other service and government sectors. Training in the latter two sectors was mostly characterized by school-based settings. Friends, relatives, or others were indicated by about one-third of the individuals that had received qualifying training in the agriculture, forestry, and fishery sector.

Region. Table 5-14 displays the data on the likelihood of training by Census region. Respondents in the West reported considerably more training than any of the other three regions. It is difficult to provide a structural reason for this fact, so it is likely that the regional variation is explained by industry andoccupational differences. The data on sources of training given in table 5-15 show that informal OJT and friends, relatives, or others are disproportionately more often indicated as sources of training in the West relative to the other regions.

Job tenure and recent job change status. The final characteristics examined for their relationships with the likelihood of having qualifying or skill improvement training were job tenure and recent job change status--for example, did the individual hold the same job a year ago or not. Table 5-16 demonstrates that there is a positive association between having taken training and length of job tenure, especially for skill improvement training. Interestingly, the relationship tails off for the very longest tenure classification, 26-plus years. Recent job changers have a much reduced likelihood of having had both qualifying and skills improvement training vis-à-vis individuals who had not changed jobs in the last year, but a greater likelihood of having qualifying or skill improvement training alone.

Table 5-15 displays the sources of qualifying training by job tenure and job change status. The data generally show a negatively signed relationship in the incidence of informal OJT, school-based training, and training from friends or relatives and job tenure and a positive association for formal company programs, Armed Forces training, and correspondence courses. These relationships may suggest recent trends toward school-based training and informal OJT and away from formal company training or military training.

Summary. The examination of aggregate first-order relationships between individuals' characteristics and the likelihood of reporting training uncovered the following results:

TABLE 5-14

PERCENTAGE OF INDIVIDUALS IN THE EXPERIENCED LABOR FORCE WITH QUALIFYING OR SKILL IMPROVEMENT TRAINING BY CENSUS REGION

Training Type	Census Region				Total
	Northeast	North Central	South	West	
Total Experienced Labor Force	22,843	28,247	36,665	21,649	109,404
Qualifying Training					
Yes	54.2%	51.4	51.0	58.1	53.2%
No	44.6	48.0	48.2	40.9	46.0
Skill Improvement Training					
Yes	28.3%	31.2	30.5	34.6	31.0%
No	60.0	55.9	58.1	53.1	56.9
Not working	11.7	12.9	11.5	12.3	12.3
Qualifying or Skill Improvement					
Neither[a]	38.1%	40.3	40.0	33.0	38.3%
Qualifying Only[a]	33.6	28.5	29.6	32.5	30.7
Skill Improvement Only	7.7	8.3	9.0	8.9	8.5
Both	20.6	22.9	21.5	25.7	22.5

NOTE: Counts of data are in thousands (000s). Column percents may not add to 100 because of missing data. Questions about skill improvement training were not administered to respondents who were not currently working.

[a] Includes respondents not currently working, so skill improvement training questions were not asked.

TABLE 5-15

PERCENTAGE DISTRIBUTION OF SOURCES OF QUALIFYING TRAINING BY CENSUS REGION

Source	Census Region				Total
	Northeast	North Central	South	West	
School	53.9%	51.5	48.2	49.0	50.4%
Formal Company Training	15.8	18.8	17.4	17.7	17.4
Informal OJT	46.8	50.2	52.2	55.2	51.2
Armed Forces	2.9	3.2	3.6	4.3	3.5
Correspondence Course	.8	1.5	1.6	1.6	1.4
Friends, Relatives, Other	4.5	6.0	6.7	7.4	6.2
Ratio $\frac{\text{Source}}{\text{Respondents}}$	1.247	1.313	1.297	1.351	1.300

NOTE: Column percents may add to greater than 100 because of multiple responses.

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TABLE 5-16

PERCENTAGE OF INDIVIDUALS IN THE EXPERIENCED LABOR FORCE WITH QUALIFYING OR SKILL IMPROVEMENT TRAINING BY JOB TENURE AND BY RECENT JOB CHANGE STATUS

	Job Tenure							Job Change	
Training Type	Not Working	0-1 Years	1-5 Years	6-10 Years	11-25 Years	26+ Years	Total	Yes	No
Total Experienced Labor Force	474	195	39,185	15,924	17,650	4,990	109,418	8,456	78,425
Qualifying Training									
Yes	37.3%	48.8	55.0	58.5	59.5	54.6	53.2%	51.1%	57.6
No	62.4	50.5	44.2	40.6	39.4	44.1	46.0	48.2	41.5
Skill Improvement Training									
Yes	0.0%	22.2	33.6	40.6	44.5	39.3	31.0%	28.8%	37.5
No	0.0%	76.4	64.6	57.6	53.5	58.5	56.9	69.9	60.7
Not working	100.0	1.4	1.7	1.8	2.0	2.2	12.1	1.3	1.8
Qualifying or Skill Improvement									
Neither[a]	62.7%	43.4	35.8	30.8	29.5	35.6	38.3%	38.2%	32.8
Qualifying only[a]	37.3	34.4	30.5	28.7	26.0	25.0	30.7	33.1	29.7
Skill Improvement only	(-)	7.8	9.2	10.7	11.0	9.8	8.5	10.7	9.6
Both	(-)	14.4	24.4	29.9	33.5	29.6	22.5	18.1	27.9

NOTE: Counts of data are in thousands (000s). Column percents may not add to 100 because of missing data. Questions about skill improvment training were not administered to respondents who were not currently working.

[a] Includes respondents not currently working, so skill improvement training questions were not asked.

TABLE 5-17

PERCENTAGE DISTRIBUTION OF SOURCES OF QUALIFYING TRAINING BY JOB TENURE AND RECENT JOB CHANGE STATUS

	Job Tenure							Job Change	
Training Type	Not Working	0-1 Years	1-5 Years	6-10 Years	11-25 Years	26+ Years	Total	Yes	No
School	29.2%	48.2	54.1	53.7	51.8	46.2	50.4%	44.5%	53.2
Formal Company Training	17.2	15.1	16.9	17.8	19.6	21.9	17.4	17.8	17.8
Informal OJT	64.0	55.1	50.0	48.7	47.5	49.7	51.2	58.9	49.3
Armed Forces	3.4	3.0	2.9	3.2	4.9	5.8	3.5	3.3	3.7
Correspondence Course	.7	1.0	1.3	1.5	1.8	2.7	1.4	1.6	1.5
Friends, Relatives, Others	8.6	7.4	5.9	5.8	4.9	6.9	6.2	7.4	5.6
Ratio $\frac{\text{Sources}}{\text{Respondents}}$	1.229	1.299	1.311	1.306	1.304	1.333	1.300	1.335	1.312

NOTE: Column percents may add to greater than 100 because of multiple responses.

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- Age of worker had a curvilinear relationship with training likelihood in which prime age individuals had the highest incidence of training.
- Blacks reported significantly less training than other races.
- Males and females had similar likelihoods of reporting training, although females reported fewer sources of qualifying training and reported a much higher use of school-based training.
- There was significant variation in training likelihood across occupations and industries; occupation had more variation than industry.
- The West had more training than other regions of the country.
- There was a positive but not particularly strong association between job tenure and training.

A shortcoming of simple cross tabulations such as those presented in tables 5-2 through 5-12 is that the relationships may not be direct, but rather may result from causal factors that are not controlled for. For example, variable y may be related to training and variable x may be correlated with variable y. When x is cross tabulated with training, a spurious relationship will appear.

Based on the observation of great occupational variation in the likelihood of reporting training and because occupation seemed to be the central causal variable in the BLS analysis, three-way tabulations between occupation, individual characteristics, and training were performed. Although controlling for occupation dampened some of the variation, virtually all of the relationships mentioned here still held true for all major occupational groups. Two substantial differences noted were first, the training likelihood variation across major industries virtually disappeared for the higher level occupations such as professional and managerial and technical workers. Second, although the aggregate data indicated only minor differences between males and females, when examining the data on an occupation-by-occupation basis, it was determined that males in sales and crafts occupations had substantially higher likelihoods of qualifying and skill improvement training than females in those occupations and vice versa for clerical jobs.

Characteristics of Individuals Who Participated in School-Based or Formal Company Training

As described in the introductory chapter, the skip pattern of the CPS supplement was designed to elicit detail about qualifying and skill improvement training programs that respondents categorized as school-based or formal company programs. (If the training received was from informal OJT, from the Armed Forces, from a correspondence course, or from non-work-related source such as a friend or relative, no further detail about the training was collected.) This section examines the characteristics of individuals who reported this additional detail.

The first relationship examined is the correspondence between sources of qualifying and skill improvement training for individuals who had both types of training. Table 5-18 arrays those data. The entries in the table provide the percentage of individuals who reported the source of qualifying training listed at the top of the table who reported getting skill improvement training from the source listed at the left. For example, 49.8 percent of the individuals who had qualifying training in a school setting and who had both qualifying and skill improvement training, got their skill improvement training in a school. As the data show, there really is little correspondence between the two sources. About 55 percent of those with formal company qualifying training and some source of skill improvement training got formal company skill improvement training. The corresponding statistics for informal OJT and other sources were only 46 percent and 25 percent, respectively. Also shown in the table are data on the individuals who reported either qualifying training or skill improvement training, but not both. Overall, about 57 percent of the individuals who reported qualifying training did not report skill improvement training. By examining the data by source of qualifying training, it is seen that about 66 percent of those with informal OJT or "Other" as a source of qualifying training did not get skill improvement training. Slightly less than half of those with school-based, formal company, or Armed Forces qualifying training did not get skill improvement training, whereas only about 35 percent of those with qualifying training from a correspondence course did not report further training.

TABLE 5-18

SOURCES OF SKILL IMPROVEMENT TRAINING BY SOURCE OF QUALIFYING TRAINING FOR INDIVIDUALS WITH BOTH TYPES

	Source of Qualifying Training						No Qualifying Training	
Source of Skill Improvement Training	School	Formal Company	Informal OJT	Armed Forces	Correspondence Course	Other	Number	Percent
(1) School	49.8%	30.3	32.3	34.7	31.4	31.6	1,794	15.7%
(2) Formal Company	30.7	56.7	35.6	48.0	44.5	29.6	2,603	24.9
(3) Informal OJT	26.3	31.6	46.2	34.7	33.6	44.7	5,604	52.6
(4) Other	16.1	12.3	15.8	17.2	33.4	25.1	624	14.5
(5) Total Count	15,276	5,199	10,940	1,082	512	1,092	N/A	N/A
(6) Ratio $\frac{\text{Sources}}{\text{Respondents}}$	1.229	1.289	1.246	1.345	1.430	1.310	N/A	N/A
No Skill Improvement Training								
(7) Number	14,015	4,949	18,804	963	294	2,511	N/A	N/A
(8) Percentage of Total[a]	47.8%	48.8	63.2	47.1	36.5	69.7	N/A	N/A

[a] Row (7) -- (Row (5) + Row (7)).

TABLE 5-19

TYPES OF SCHOOLS ATTENDED FOR SCHOOL-BASED QUALIFYING AND SKILL IMPROVEMENT TRAINING FOR INDIVIDUALS WITH BOTH SOURCES OF TRAINING

	School Type for Qualifying Training				
School Type for Skill Improvement Training	High School Vocational	Private Postsecondary Vocational	Public Postsecondary Vocational	Junior or Community College, Technical Institute	Four-Year College
High School Vocational	18.3%	4.0	2.5	2.6	.1
Private, Postsecondary Vocational	10.9	45.0	7.1	6.5	4.2
Public, Postsecondary Vocational	13.8	5.0	45.6	4.1	2.2
Junior or Community College, Technical Institute	45.3	38.0	33.2	70.1	12.4
Four-Year College	19.6	22.7	27.9	23.9	84.3
Total Count	688	300	283	1,060	4,825

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About 27 percent of those with skill improvement training did not need qualifying training, but again there was discrepancy across the sources of skill improvement training. Over half of the respondents who indicated that they received skill improvement training through informal OJT did not need qualifying training. On the other hand, only around 15 percent of those who received skill improvement training in schools or from other sources did not need qualifying skills or training.

A second relationship examined was the correspondence between the types of schools reported when a individual had both school-based qualifying and skill improvement training. These data are displayed in table 5-19. Here the correspondence between the school types is reasonably high with the exception of having received school-based qualifying training in a high school vocational program. In that instance, individuals' school-based skill improvement training had highest likelihood of being in a community college, but there were also substantive flows into all of the other types of school programs. If qualifying training was in a private, postsecondary vocational program, then skill improvement training was also in a private, postsecondary vocational program or a community college or a university. A very similar story holds for public, postsecondary vocational program attendees. For those respondents who took their qualifying training in a junior or community college, there was a high likelihood that their skill improvement training came in a similar institution (70.1 percent) or at a 4-year college (23.9 percent). College-trained individuals tended to return to 4-year institutions for skill improvement training, although a sizable number went to junior or community colleges. Figure 5-4 illustrates the major flows between types of school.

A characteristic of training programs that may be associated with participants' characteristics is the sponsorship of the program. This determines the level of investment from individuals and may be important in determining access. Table 5-20 provides data on the characteristics of individuals who reported training (either qualifying or skill improvement in either a school-based setting or a formal company training program) that was sponsored by a government program such as CETA. The table also provides data on individuals who reported school-based qualifying or skill improvement training that was paid for by an employer.

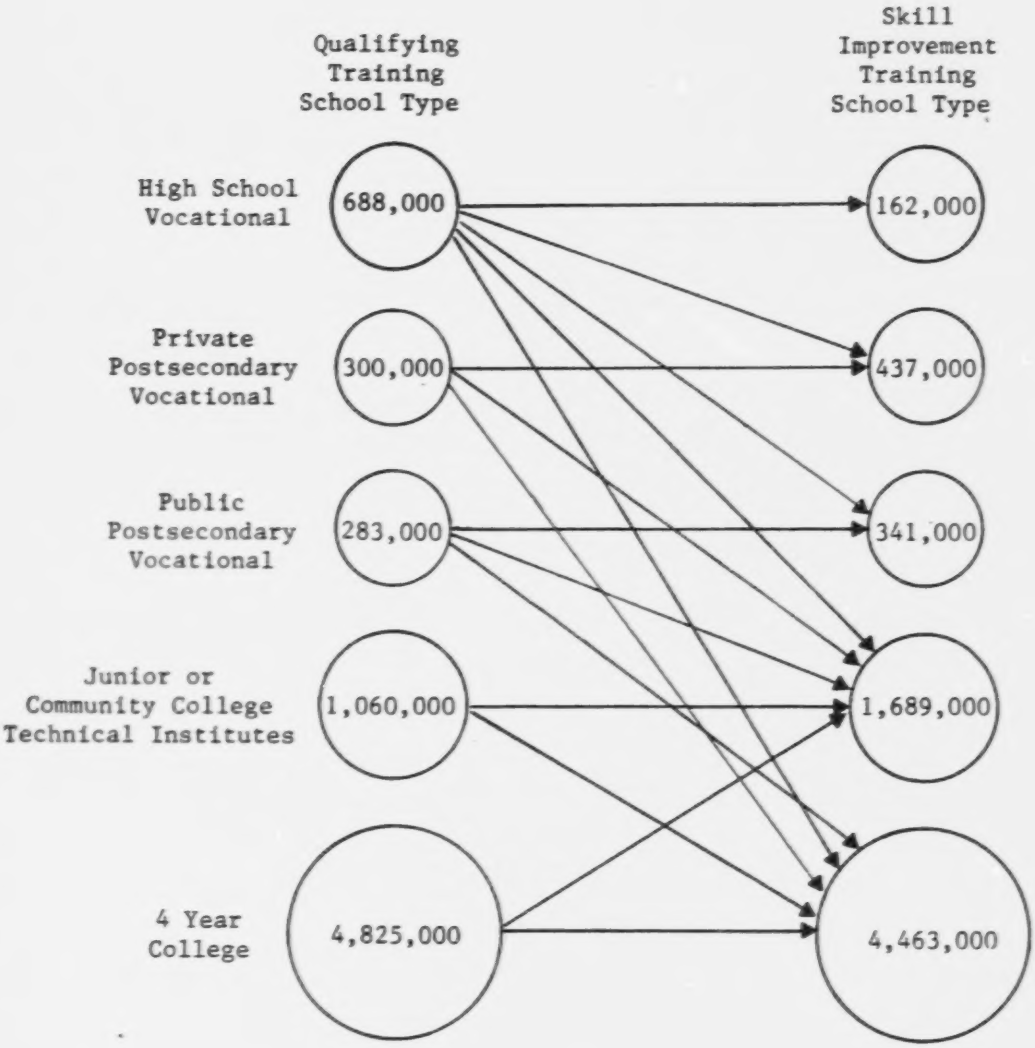
Qualifying Training School Type
Skill Improvement Training School Type
High School Vocational
688,000
Private Postsecondary Vocational
300,000
Public Postsecondary Vocational
283,000
Junior or Community College Technical Institutes
1,060,000
4 Year College
4,825,000
162,000
437,000
341,000
1,689,000
4,463,000

Figure 5-4. School sequences for individuals with both school-based qualifying and skill improvement training.

TABLE 5-20

CHARACTERISTICS OF RECIPIENTS OF GOVERNMENT-SPONSORED SCHOOL OF FORMAL COMPANY TRAINING AND OF EMPLOYER-PAID SCHOOL TRAINING

Characteristics	Total with Some Training	Government Sponsored		Total with School Training	Employer Paid	
		Yes	No		Yes	No
Total	67,518	3.0%	97.0	33,088	18.9%	81.1
Age						
Under 20	2,409	1.8%	98.2	673	8.2%	91.8
20-24	8,400	2.9	97.1	3,961	13.4	86.6
25-34	21,453	3.1	96.9	11,459	19.3	80.7
35-44	16,017	3.2	96.8	8,169	21.4	78.6
45-54	10,851	3.0	97.0	5,134	21.2	78.8
55-64	7,084	3.0	97.0	3,135	17.8	82.2
65+	1,305	1.8	98.2	556	14.0	86.0
Race						
White	60,318	2.7%	97.3	29,911	19.3%	80.7
Black	5,475	6.2	93.8	2,301	17.1	82.9
Other	1,711	4.1	95.9	858	12.8	87.2
Sex						
Male	38,496	2.9%	97.1	16,994	22.0%	78.0
Female	29,006	3.2	96.8	16,070	15.7	84.3
Education						
Less than high school	7,970	3.0%	97.0	1,015	21.5%	78.5
High school graduate	25,442	3.0	97.0	8,414	20.5	79.5
Some post-secondary	14,525	3.4	96.6	7,643	20.8	79.2
College Graduate	19,472	2.6	97.4	16,006	17.1	82.9
Major Occupation						
Management, Professional	21,444	3.0%	97.0	16,458	18.8%	81.2
Technical	2,916	4.6	95.4	1,993	19.1	80.9
Sales	6,494	1.3	98.7	2,118	21.0	79.0
Clerical	11,678	2.8	97.2	6,326	14.0	86.0
Service	6,332	5.3	94.7	2,229	22.9	77.1
Crafts, semiskilled	16,320	2.8	97.2	3,446	24.8	75.2
Unskilled Agriculture	2,322	2.0	98.0	510	19.6	80.4
Armed Forces	12	0.0	100.0	4	0.0	100.0

TABLE 5-20--Continued

Characteristics	Total With Some Training	Government Sponsored		Total with School Training	Employer Paid	
		Yes	No		Yes	No
Major Industry						
Ag., For., Fish.	1,358	1.8%	98.2	524	20.8%	79.2
Mining and Const.	5,139	2.7	97.3	1,568	19.8	80.2
Manufacturing	13,173	2.2	97.8	5,260	24.7	75.3
TCPU[a]	4,970	2.4	97.6	1,531	23.2	76.8
Trade	10,489	1.6	98.4	3,030	17.0	83.0
FIRE[b]	5,119	1.6	98.4	2,739	24.2	75.8
Services	23,266	3.7	96.3	16,024	14.8	85.2
Government	3,999	8.6	91.4	2,406	27.0	73.0
Census Region						
Northeast	14,130	2.9%	97.1	7,289	19.2%	80.8
North Central	16,867	2.9	97.1	8,501	20.6	79.4
South	22,009	3.2	96.8	10,270	18.9	81.1
West	14,504	3.0	97.0	7,021	16.8	83.2
Job Tenure						
Not working	4,286	4.6%	95.4	1,269	7.6%	92.4
0-1	11,422	3.0	97.0	5,132	9.5	90.5
1-5	25,142	2.8	97.2	13,114	18.3	81.7
6-10	11,015	2.9	97.1	5,718	22.6	77.4
11-25	12,442	2.9	97.1	6,396	25.5	74.5
26+	3,211	2.6	97.4	1,458	24.3	75.7
Job Change Status						
Same job	52,667	2.8%	97.2	27,310	20.7%	79.3
Different job	5,227	2.3	97.7	2,170	15.6	84.4
Not working	9,612	4.2	95.8	3,519	7.8	92.2

NOTE: Totals are reported in thousands (000s).

[a] TCPU--Transportation, Communication, and Public Utilities

[b] FIRE--Finance, Insurance, and Real Estate

Most of the school-based or formal company training was not government sponsored. In fact, only 3 percent was. Thus, it is difficult to determine when there are particular statistical associations between government sponsorship and individual characteristics. With that caveat in mind, following is a list of tentative relationships:

- Prime age individuals who had received training tend to have a higher likelihood of government sponsorship than young or older workers who reported training.
- Blacks have a higher likelihood of government sponsorship.
- The major occupations with workers who reported taking government-sponsored training are technical and service occupations.
- The major industrial sectors with workers who reported taking government-sponsored training are services and the government sectors.
- Workers not currently holding a job have a higher incidence of government-sponsored qualifying training than their employed counterparts.

Overall employers paid for about 19 percent of school-based training. Employers tended to pay for school-based training for the following types of workers:

- Prime age
- White
- Males
- Less well educated
- Service or crafts occupations
- Manufacturing, TCPU, and FIRE sectors
- More tenured
- Workers who had not recently changed jobs.

The final training characteristic examined was whether the respondent had completed the training or not. Table 5-21 provides the overall completion rates of school-based and formal company qualifying and skill improvement training for various population groups. With the exception of school-based skill improvement training, the completion rates for the population of individuals who had undergone the training were generally around 90-95 percent. Only about three-fourths of the individuals who had engaged in school-based skill improvement training had completed. Presumably a number of the CPS respondents were still currently engaged in this type of training.

TABLE 5-21

CHARACTERISTICS OF SCHOOL-BASED AND FORMAL COMPANY TRAINING PROGRAM COMPLETERS

	Qualifying				Skill Improvement			
	School-Based		Formal Company		School-Based		Formal Company	
Characteristics	Number With Training	Percent Complete	Number with Training	Percent Complete	Number with Training	Percent Complete	Number with Training	Percent Complete
Total	27,950	92.6%	9,553	95.2%	10,507	77.4%	9,921	93.8%
Age								
Under 20	521	79.7%	161	90.7%	197	35.0%	105	82.9%
20-24	3,318	86.8	948	91.8	948	53.6	913	87.0
25-34	9,837	92.8	3,139	93.4	3,425	71.1	3,360	92.4
35-44	6,926	93.6	2,605	96.3	2,842	82.7	2,724	94.8
45-54	4,209	94.6	1,620	97.9	1,896	86.9	1,754	96.5
55-64	2,635	95.2	950	97.3	1,063	92.9	95.9	97.3
65+	505	96.6	129	100.0	137	96.4	112	98.2
Race								
White	25,305	92.6%	8,551	95.2%	9,615	77.7%	9,056	93.7%
Black	1,877	91.7	786	95.0	692	72.3	626	93.5
Other	755	93.6	210	95.7	194	79.9	232	96.1
Sex								
Male	14,097	92.4%	6,299	94.8%	5,625	78.3%	6,133	94.4%
Female	13,840	92.8	3,251	96.0	4,881	76.4	3.784	92.7
Education								
Less than high school	678	83.9%	889	96.7%	380	75.0%	593	93.8%
High school graduate	6,474	94.3	3,991	95.1	2,410	79.3	3,524	93.6
Some postsecondary	6,113	82.7	2,424	94.8	2,527	68.9	2,432	93.3
College graduate	14,681	96.4	2,248	95.2	5,191	80.8	3,372	94.2
Major Occupation								
Managment, professional	14,768	94.3%	2,446	95.5%	5,731	80.6%	3,540	94.6
Technical	1,752	90.6	426	97.4	542	65.1	520	92.3
Sales	1,626	91.4	1,309	96.3	725	79.3	1,332	94.1
Clerical	5,330	90.4	1,174	95.4	1,439	71.1	1,485	92.7
Service	1,623	92.4	1,100	97.4	779	76.5	879	94.8
Crafts, semiskilled	2,504	90.2	2,974	93.2	1,089	74.4	2,044	92.9
Unskilled, agriculture	343	88.9	122	96.7	202	76.7	121	91.7
Armed Forces	2	100.0	3	100.0	(-)	(-)	(-)	(-)
Major Industry								
Ag., For., Fish.	388	92.8%	50	100.0%	197	84.3%	79	97.5%
Mining and constr.	1,223	91.9	870	89.7	465	75.5	380	87.1
Manufacturing	4,345	90.2	1,899	95.0	1,500	74.3	1,863	94.0
TCPU[a]	1,208	90.2	1,121	96.4	439	79.0	1,232	96.0
Trade	2,393	90.1	1,297	96.3	802	70.4	1,462	94.8
FIRE[b]	2,187	92.2	1,069	97.2	872	81.8	1,185	92.2
Services	14,335	94.1	2,435	94.8	5,312	77.6	2,618	92.8
Government	1,867	92.4	806	96.9	920	81.6	1,105	95.2
Census Region								
Northeast	6,259	93.7%	1,813	94.8%	2,069	74.2%	1,757	93.4%
North Central	7,116	92.6	2,579	95.7	2,926	78.4	2,425	94.4
South	8,600	92.0	3,052	95.0	3,103	77.9	3,401	93.3
West	5,971	92.3	2,109	95.2	2,410	78.3	2,339	94.0
Job Tenure								
Not working	1,153	87.9%	709	95.3%	57	61.4%	56	89.3%
0-1	4,558	89.1	1,419	93.4	944	55.6	1,035	82.9
1-5	11,124	92.9	3,397	93.6	3,963	70.3	3,717	92.9
6-10	4,762	94.1	1,538	96.9	2,126	81.0	1,964	95.8
11-25	5,156	94.4	1,925	97.5	2,873	88.9	2,505	96.9
26+	1,196	93.8	565	97.0	545	93.0	643	98.3
Job Change Status								
Same Job	22,876	93.6%	7,532	95.7%	9,498	79.7%	8,819	95.1%
Different Job	1,859	89.2	723	93.8	502	56.4	612	83.3
Not Working	3,205	87.3	1,294	93.0	502	54.8	484	82.6

NOTE: Totals are reported in thousands (000s).

[a] TCPU--Transportation, Communication, Public Utilities

[b] FIRE--Finance, Insurance, and Real Estate

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Across the population, completion rates seem to increase with age and tenure of the workers as would be expected. There is no systematic relationship between race, sex, industry, occupation, or census region and completion rates. For educational attainment, there is a not unexpected relationship between completion rates of school-based qualifying and skill improvement training and highest grade completed. Individuals with less than a high school diploma and those with some postsecondary education have lower completion rates than individuals who are high school graduates or college graduates. Obviously those without the high school or college credential did not complete their vocational training. The next section of the document extends the analyses that have been presented through multivariate analytic techniques.

5.3. Multivariate Analyses of the Determinants of Qualifying and Skill Improvement Training

Based on insights from tabular and cross-tabular examination of the CPS data on training, the next two sections focus on multivariate models. Three basic phenomena will be described: (1) determinants of which individuals hold jobs for which specific skills or training were prerequisites, (2) determinants of which individuals obtained skills or training while holding their current jobs, and (3) what effect these types of skills and training have on individual earnings. Detail about sources and types of training will also be examined, especially regarding their effects on earnings.

Simple models of the processes underlying training and earnings characteristics will be presented in order to provide a basis for the subsequent statistical analysis. In these models, certain concepts, such as human capital, match value, and screening will be used.

Human capital, simply defined, measures the productivity of the individual worker. It is commonly broken down into three categories: general, occupation-specific, and firm-specific. The total productivity of an individual in a given firm and occupation would be the sum of these three types of human capital. Each type may have three possible sources: innate ability, explicit training or schooling, and learning-by-doing. For instance, general human capital acquired by training may be the knowledge gained from a college

English course that improves writing skills. However, good writing skills might be acquired less explicitly through extensive reading and habitual letter writing, which would be categorized as learning-by-doing. Examples of occupation-specific and firm-specific skills can be given similarly. Our prior notion is that occupation-specific skills are gained mostly from innate ability and explicit training, whereas firm-specific skills are obtained through learning-by-doing and very little through innate ability. Innate ability can enhance one's efficiency in acquiring human capital via the other sources.

Although human capital can refer to a variety of things, it is important to keep in mind that those skills considered to be prerequisites for certain jobs in the survey questions used here are primarily occupation-specific skills acquired through explicit training. More general skills and a certain amount of experience may be taken for granted. Similarly, acquisitions of skills while at the current job may not include some firm-specific skills or those acquired by learning-by-doing.

Correctly explaining and modeling lifetime investment in and subsequent returns to human capital is made complex when different types of human capital and modes of investment are considered. The principal models in the literature (Ben-Porath 1967, Weiss 1972, Heckman 1976) use only one type of human capital and investment mode to calculate optimal age-investment profiles and subsequent age-earnings profiles. Less complete but still revealing models of investment and earnings have incorporated both general and firm-specific human capital but do not explicitly differentiate investment mode (Lazear 1979, Hashimoto 1981, Bartel and Borjas 1977). Similarly, some work has been done involving occupation-specific investment (Shaw 1984) or different modes of investment (Ormiston 1979). However, a model incorporating the full range of human capital types and investment modes has not been developed in the literature.

The process of human capital acquisition and earnings is further complicated by varying theories about how labor markets work. The simplest theory is that workers are paid according to their value of marginal product at each point in time. A more general outlook that considers employee tenure, employee firm contracts, and a need for smoothing of income flows would more likely call for the equality of discounted expected earnings and discounted expected productivity as the result of an efficient labor market.

A training period in which firm-specific capital is acquired and some expectation that the employee will remain with the firm could lead to a wage profile that is flatter than the productivity profile. Uncertainty about an employee's actual or potential productivity with the firm could lead employers to screen applicants on the basis of past credentials or on-the-job training (Arrow 1972, Stiglitz 1975, Spence 1973). It may also lead the employer to provide incentives for potential employees to self-select in a desirable manner (Salop and Salop 1976, Guasch and Weiss 1981). Employee and employer may be equally uninformed about the potential value of a "job match", resulting in an efficient cooperative solution (Jovanovic 1979). Institutional and other considerations may lead employers to pay on the basis of seniority rather than productivity (Medoff and Abraham 1981). Each of these theories present somewhat different, and often conflicting, views of the relationship of earnings and productivity profiles. Although some empirical testing of these theories has been done, no clear conclusion has been reached. In the course of the statistical analysis reported here, the implications of certain results for human capital and labor market theories will be explored. In general, though, the clarity of the interpretation of some statistical results is limited by the absence of a comprehensive model and the lack of more extensive longitudinal data.

Training as a Job Prerequisite (Qualifying Training)

The first problem is to reduce this question to manageable proportions: What determines which individuals will hold jobs that have some skill or training prerequisite? While skill acquisition and subsequent employment and earnings are almost certainly simultaneously determined, the first simplification is to take existing human capital prior to hiring as exogenous. Let S_i be the skill level of individual i before joining the firm (S_i could either be a scalar or a vector of skills). Let S^*_{jk} be the skill prerequisite of occupation j at firm k. Let S^* be the skill level above which one is considered "skilled." If we assume strict adherence to prerequisites in the hiring process, a "preskilled" person is hired into a skilled job only when

$S_i \geq S^*_{jk} \geq S^*$. The other condition for observing this is that the person actually applied for the job and was hired.

The CPS sample is comprised of people who have been matched with jobs. Hence they have been hired and presumably $S_i \geq S^*_{jk}$. Formally it would be said that (uncorrectable) sample selection conditions were applied. The only question then is whether $S^*_{jk} \geq S^*$. If P is a binary variable for being preskilled, then under these conditions

(1) $P = f(S^*_{jk}, S^*)$

and we should be able to estimate this relationship without use of individual characteristics. This will be done using job type variables as proxies for skill requirements.

Taking the opposite tack, we could assume that all preskilled people get skilled jobs, so that $P = g(S_i, S^*)$. Although it is less realistic, it will be interesting to compare this specification to the previous one.

A less restrictive assumption is that the skill requirements for any given job are not exact and that an underskilled person may be hired for the job if other conditions are favorable. More formally, the probability of being hired is $h(S_i - S^*_{jk}, M_{ijk})$ where M_{ijk} represents other job match conditions, such as hiring and application costs, informal information about each other, and so forth. M_{ijk} will be said to be more positive when conditions are more favorable, and hence we assume $h_1 > 0$, $h_2 > 0$. While the condition for being a preskilled worker is still $S_i \geq S^*_{jk} \geq S^*$, the variable M_{ijk} represents potentially important interaction and selection effects, so we specify

(2) $P = f^*(S_i, S^*_{jk}, S^*, M_{ijk})$.

Implementing these specifications empirically involves several adjustments. Although it may be possible to construct continuous variables that represent S^*_{jk}, the most direct way is to use a set of industry and occupation dummy variables. No information about the firm is available on the CPS, aside from whether the job is government, private, or self-employment. S_i is represented by a set of variables including demographic characteristics, education, and experience. S^* is presumably a constant. M_{ijk} can be represented by prior experience in the firm, minority, and veteran-status variables for affirmative-action effects and cohort variables for changing skill requirements over time. Some variables could easily represent both S_i and M_{ijk}, and these effects will be discussed.

First, a linear probability model for qualifying training was estimated based solely on job characteristics (S^*_{jk}), which were proxied by 44 occupational dummies, 50 industry dummies, government and self-employed dummies, part-time status, and years of experience in the firm prior to taking the current job. Coefficient estimates for the occupational and industry dummies are shown in the "qualifying training" columns of tables 5-22 and 5-23, respectively. For comparison, the intercept probability of having qualifying training for a full-time worker in a private firm with no prior firm experience is 0.4796, using a sample of all employed workers in the CPS sample.

The estimates show that occupational categories have wider dispersion in their effects on training probabilities than do industry categories, and hence they are stronger determinants of training. Within occupations, the categories most likely to have had qualifying training are professional specialists followed by technician categories, executives and managers, upper-level administrative and sales people, and craftsworkers. Lowest are service workers and laborers. Among industry categories, highest are some public administration groups and aircraft and petroleum manufacturers. Lowest are private household, non-specified metal, furniture, and leather manufacturing workers. It is notable that self-employment has a small negative effect (-.012) and the government effect is essentially 0 (0.0008). The adjusted R-squared in this regression was 0.2528. For a similar regression using only 13 occupation categories and 22 industry categories, this statistic was 0.2200 revealing that the broader job classifications are not that much more heterogeneous.

Table 5-24 presents results from three linear probability regressions on qualifying training: one on individual characteristics alone; one that includes individual, occupation, and industry characteristics; and a third that includes all of these as well as some added interaction terms. Experience variables may represent individual-firm interactions as well as individual characteristics.

Examining the first regression reveals some basic features of individuals whose jobs require qualifying training. Non-head-of-household females are most likely to have had qualifying training, followed by female heads, male heads, and last, non-head-of-household males. Whites are most likely to have

TABLE 5-22

TRAINING REGRESSION COEFFICIENTS FOR OCCUPATIONAL VARIABLES

Qualifying Training Rank	Occupational Category	Qualifying Training Regression Coefficient	Skill Improvement Training Regression Coefficient	Skill Improvement Training Coefficient Rank
1.	Health diagnosing professionals	.5058	.5083	1
2.	Teachers, college & university	.4993	.2652	15
3.	Health assessment & treatment	.4982	.4191	3
4.	Natural scientists	.4960	.3549	6
5.	Teachers, excluding college & university	.4925	.4373	2
6.	Engineers	.4425	.3342	7
7.	Health technologists & technicians	.4398	.2880	13
8.	Mathematical & computer scientists	.4301	.4164	4
9.	Lawyers & judges	.4248	.3090	10
10.	Other professional speciality	.3984	.2938	11
11.	Other technicians	.3723	.3284	8
12.	Engineer & science technicians	.3219	.2640	16
13.	Management related workers	.3096	.2916	12
14.	Computer equipment operators	.3050	.2306	22
15.	Sales representatives, finance, & business workers	.2804	.3625	5
16.	Secretaries, stenog., & typists	.2720	.0557	36
17.	Other executives, administration, & managers	.2501	.2426	20
18.	Mechanics & repairers	.2412	.2528	19
19.	Officials & administration, public administration	.2279	.3104	9
20.	Construction trades workers	.2098	.1306	28
21.	Sales workers	.2044	.2814	14
22.	Other precision products, crafts & repair workers	.1808	.1761	25
23.	Health service personnel	.1693	.1988	23
24.	Financial records processors	.1584	.0848	32
25.	Sales representatives, comodities, excl. retail workers	.1573	.2626	17
26.	Supervisors (admin. support)	.1557	.2536	18
27.	Supervisors & proprietors	.1062	.1805	24
28.	Personal service workers	.0843	.1585	26
29.	Protective service workers	.0498	.2332	21
30.	Other administration, including clerical people	.0331	.1181	29
31.	Forestry & fishing workers	excluded	excluded	42
32.	Fabricators, assemblers, inspectors, & samplers	-.0032	.0758	33
33.	Farm operators & managers	-.0225	.1495	27
34.	Other transportation & material moving workers	-.0261	.0587	35
35.	Machine operators & tendors, executive precision workers	-.0388	.0616	34
36.	Motor vehicle operators	-.0750	-.0073	43
37.	Sales workers, retail & personal	-.0853	.0975	30
38.	Farm workers & related	-.1168	.0294	38
39.	Food service workers	-.1242	.0156	40
40.	Private household service workers	-.1380	.0893	31
41.	Other handlers, equip. cleaners, helpers, & laborers	-.2046	.0057	41
42.	Mail & message distributors	-.2278	.0335	37
43.	Freight, stock, & material handlers	-.2419	-.0159	44
44.	Construction laborers	-.2500	.0189	39
45.	Cleaning & building service workers	-.2997	-.0782	45

UNIVERSE: All employed persons in the January 1983 Supplemental CPS (n = 62,909).

NOTE: Most coefficient standard errors are in the range 0.01-04, hence if the coefficients are independent, a difference of approximately 0.07 implies a significant difference between the 2 categories.

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TABLE 5-23

TRAINING REGRESSION COEFFICIENTS FOR INDUSTRY VARIABLES

Qualifying Training Rank	Industrial Category	Qualifying Training Regression Coefficient	Skill Improvement Training Regression Coefficient	Skill Improvement Training Coefficient Rank
1.	Justice, public order & safety	.0773	.0682	2
2.	National security & internal affairs	.0490	.0548	4
3.	Aircraft & parts manufacturing	.0468	.0168	11
4.	Administration of human resource programs	.0439	-.0016	15
5.	Other professional service	.0393	-.0162	16
6.	Petroleum & coal products	.0323	.0088	12
7.	Hospitals	.0278	.0181	10
8.	Personal services, excluding private HH	.0256	-.0754	27
9.	Other transportation & equipment manufacturing	.0247	.0394	7
10.	Banking & other finance	.0186	.0469	6
11.	Forestry & fisheries	.0165	.0580	3
12.	Machinery, except electrical, manufacturing	.0154	-.0234	18
13.	Insurance & real estate	.0138	.0320	9
14.	Health services, excluding hospitals	.0074	-.0001	14
15.	Transportation	.0068	-.0568	22
16.	Repair services	.0024	-.1364	41
17.	Educational services	.0021	-.0167	17
18.	Other public administration	excluded	excluded	13
19.	Construction	-.0006	-.1187	37
20.	Utilities & sanitary services	-.0061	.0486	5
21.	Mining	-.0071	-.0708	25
22.	Agricultural services	-.0092	-.0673	24
23.	Business services	-.0094	-.0902	31
24.	Communications	-.0183	.0837	1
25.	Chemical & allied products	-.0221	.0331	8
26.	Professional & photo equipment	-.0231	-.0387	21
27.	Printing, publishing & allied industry	-.0234	-.1232	39
28.	Stone, clay, glass & concrete products	-.0280	-.0760	28
29.	Fabricated metals manufacturing	-.0319	-.0892	30
30.	Primary metals manufacturing	-.0472	-.0993	34
31.	Electrical machinery, equipment & supplies	-.0658	-.0609	23
32.	Textile mill products	-.0780	-.0724	26
33.	Tabacco manufacturing	-.0782	-.1767	46
34.	Wholesale trade	-.0817	-.0967	33
35.	Entertainment & recreation	-.0871	-.1680	45
36.	Paper & allied products	-.0879	-.0302	19
37.	Social services	-.0901	-.0378	20
38.	Retail trade	-.0925	-.0938	32
39.	Motor vehicles & equipment	-.1009	-.1035	35
40.	Apparel & other finished textile products	-.1067	-.1843	47
41.	Other agricultural	-.1263	-.1214	38
42.	Toys, amusement, & sporting goods	-.1290	-.0876	29
43.	Misc. & n.e.c. manufacturing industries	-.1328	-.1527	42
44.	Lumber & wood products, excluding furniture	-.1600	-.1632	44
45.	Rubber & misc. plastics manufacturing	-.1614	-.1140	36
46.	Food & kindred products	-.1690	-.1274	40
47.	Furniture & fixtures	-.1692	-.2034	48
48.	Leather & leather products	-.1832	-.1574	43
49.	Private household services	-.1899	-.2346	49
50.	Not specified metal manf.	-.4408	-.3108	50

UNIVERSE: All employed persons in the January 1983 Supplemental CPS (n = 62,909).

NOTE: Most coefficient standard errors are in the range 0.01-04, hence if the coefficients are independent, a difference of approximately 0.07 implies a significant difference between the 2 categories.

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TABLE 5-24

LINEAR PROBABILITY REGRESSION ESTIMATES OF PRIOR TRAINING

(t-statistics in parentheses)*

Variable	Model 1		Model 2		Model 3	
Intercept	.192	(5.57)	.224	(6.25)	.198	(5.25)
Male	-.078	(-10.7)	-.045	(-6.06)	-.045	(-5.99)
White	.060	(10.2)	.050	(8.91)	.051	(8.94)
Hispanic	-.018	(-1.96)	-.015	(-1.78)	-.015	(-1.69)
Married	.022	(3.01)	.006	(0.89)	.006	(0.90)
Never married	-.047	(-6.00)	-.029	(-3.85)	-.029	(-3.85)
Household head	.084	(11.1)	.043	(5.74)	.042	(5.61)
Veteran	.024	(4.42)	.017	(3.19)	.017	(3.27)
Inside SMSA	.033	(8.87)	.020	(5.60)	.020	(5.60)
Female household head	-.038	(-3.37)	-.025	(-2.30)	-.024	(-2.23)
Schooling						
Yrs. of grade school	-.009	(-1.54)	-.011	(-2.01)	-.008	(-1.54)
Yrs. of high school	.033	(6.37)	.029	(5.95)	-.031	(6.18)
Yrs. of college	.089	(31.2)	.057	(20.5)	.058	(20.5)
Yrs. of master's work	.109	(15.2)	.065	(9.29)	.066	(9.38)
Yrs. of post-master's work	-.004	(-0.40)	-.038	(-3.55)	-.035	(-3.31)
Completed grade school	.010	(0.45)	.011	(0.50)	.010	(0.46)
Completed high school	-.005	(-0.36)	-.028	(-2.31)	-.029	(-2.37)
Completed college	-.080	(-7.03)	-.059	(-.059)	-.059	(-5.46)
Experience						
Occupational exper. previous firms	.0232	(31.4)	.0180	(24.9)	.0247	(16.2)
Occupational exper. previous firms^2	-.00057	(-21.2)	-.00044	(-17.2)	-.00047	(-17.8)
Firm experience, previous occupa.	.0137	(12.0)	.0122	(8.76)	.0103	(3.68)
Firm experience previous occupa.^{2}	-.00040	(-8.26)	-.00036	(-6.95)	-.00035	(-6.73)
Occupational exper., present firm	.0064	(11.1)	.0007	(1.26)	.0007	(0.58)
Occupational exper., present firm^2	-.00018	(-10.6)	-.00004	(-2.08)	-.00003	(-1.99)
Other previous experience	-.0007	(-1.51)	-.0012	(-2.43)	-.0013	(-2.63)
Other previous experience^2	-.00007	(-5.57)	-.00004	(-3.39)	-.00004	(-2.97)
Other previous exper., female	---	---	-.00008	(-0.25)	-.00010	(-0.29)
Switched occupation within firm	---	---	-.028	(-4.77)	-.028	(-4.71)
Occup. and industry variables	(absent)		(present)		(present)	
Government sector	---	---	-.010	(-1.39)	-.010	(-1.39)
Self-employed	---	---	.015	(2.32)	.015	(2.35)
Part-time	---	---	-.060	(-12.8)	-.060	(-12.8)
Educ. x occp. exp.	---	---	---	---	.00046	(-4.97)
Educ. x firm exp.	---	---	---	---	.00013	(0.76)
Educ. x firm occp. exp.	---	---	---	---	.00000	(0.03)
R^2		.1884		.2667		.2670

UNIVERSE: All employed persons in the January 1983 Supplemental CPS (n = 62,909).

*Significance levels: If |t| > 1.645, the coefficient is significant at the .10 level.
If |t| > 1.96, the coefficient is significant at the .05 level.
If |t| > 2.576, the coefficient is significant at the .01 level.

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had qualifying training, followed by blacks and then Hispanics. Similarly, those married, spouse present, are most likely to have qualifying training, followed by those separated, divorced, or widowed, and lastly, those never married. Veterans and those living inside SMSAs are more likely to have had prior training. These effects are still present when job characteristic variables are added, and some of them may reflect sample selection effects. For example, males are traditionally more likely to work, training or no training, and hence be in the sample, whereas females, especially non-heads-of-household females, have higher reservation wages and are less likely to work unless they have specific skills that increase their market wage.

The years of schooling variables represent years in different levels of schooling, with the ranges being 0-8 years for grade school, 0-4 years for high school and college, and 0-2 for master's work and postmaster's work. In addition, we have included three dummy variables for completing--having the maximum number of years--grade school, high school, and college in order to allow for a "completion" effect. The estimated coefficients reveal that years in high school, college, and master's work are progressively stronger determinants of prior training except that completing college has a significantly negative effect. Hence, having some college education makes it much more likely that one will take a job requiring prior training, but following through to a bachelor's degree does not add to this probability. This probably reflects the occupational skills acquired in many 2-year programs and the more general, less occupation-specific skills acquired in a 4-year program. Continuing into a master's programs implies that knowledge acquired at that level is very likely to be used at a job. However, additional graduate education at the Ph.D. or professional degree level does not add to this probability, possibly because after 2 years of graduate work the probability is already very high.

Four prior work experience variables are used in the equations. The occupational experience at previous firms variable measures years working in the present occupation but not at the present firm. Similarly, the firm experience in previous occupations variable measures years at the present firm but not in the present occupation. Only one of these two variables can be nonzero as measured here--they are derived from measures of (1) years in the present occupation and (2) years at the present firm, both of which are presumed to be contiguous. Hence, if total occupational experience is greater than total firm experience, only the occupational experience at previous firms variable is positive, and vice versa. The occupational experience at the present firm measures the minimum of the occupational and firm experience variables. The other previous experience variable measures the number of years between leaving school and starting in either the present firm or the present occupation, whichever occurred earlier. This is presumably a measure of the least relevant experience and may include years not working. Together, the four experience variables should sum the number of years between leaving school and the present.

The estimated coefficients show that each of the three relevant experience variables have a significantly positive but declining effect on the probability of having had qualifying training. The previous occupational experience variable is strongest, showing that previous occupational skills are the most likely to be carried over into the current job, or that occupational skills are most likely to be considered "training." The previous firm experience variable has a somewhat smaller but still very significant coefficient, showing that either or both firm-specific skills and related occupational skills carry over into the present job, but not as strongly as direct occupational experience. The experience in the present job should have no causal effect on the skills required to obtain that job; hence, it is purely a selection effect--those with more skills are likely to have longer tenure.

This effect, while quite significant, is much smaller than the other two experience effects. Years of nonrelevant experience have a significantly negative effect (in the quadratic term), indicating that skills in nonrelated jobs do not carry over very well, and that skills acquired in school depreciate over time. A comparison of the school and experience variables shows that a year in school in any level between high school and master's work has a greater effect on the probability of qualifying training than a year of any kind of experience, which reflects the greater intensity, even after depreciation, of the human capital investment during school.

Some coefficients show a marked change from model 1 to models 2 and 3. This is due partly to the presence of industry and occupation dummies, and partly to the inclusion of the part-time status variable in the latter regressions, because a large number of part-timers are going to school and have unskilled jobs. Their inclusion reduces the effects of almost all of the individual characteristics. Clearly, the more specific information about the job that one has, the less that individual characteristics are necessary to predict qualifying training. Omitting all individual, school and experience variables except previous firm experience only reduces the adjusted R^2 to 0.2200 (as noted in table 5-22) from the 0.2667 of model 2, compared to the 0.1884 in model 1.

This suggests that job characteristics alone are somewhat better determinants of training than individual characteristics alone, and that there is considerable overlap in the variation that they explain. Nevertheless, nearly all of the individual characteristic effects are still significant in the same way whether or not job-description variables are included. However, the selection effect of years at the present job is reduced drastically. Using a dummy for switching occupations within a firm reveals an individual-firm interaction effect which reduces the formal skill requirement for a job. In addition, the education-experience interactions present in model 3 show that there is some overlap of the predictive ability of education and occupational experience and that the coefficients of these education and experience variables rise somewhat when this interaction is allowed. However, there is no significant interaction between education and other forms of experience.

Table 5-25 presents linear probability regressions of qualifying training done separately by race and sex. Although the similarity in R^2's reveals that this training is equally explainable (or random) in each case, there are some differences worth noting. First, the marriage coefficient for white women suggests that they are less likely to hold a job and hence be in the sample than other populations, unless they have specific skills. Minority women have the largest negative coefficient for being unmarried and a household head, and minority men do not benefit from being inside a city. The veteran effect is large for women, but there are so few women veterans that the standard error is also large.

TABLE 5-25

LINEAR PROBABILITY REGRESSIONS ESTIMATES OF QUALIFYING TRAINING BY RACE AND SEX

(t-statistics in parentheses)

Variable	White Males		White Females		Black/Hispanic Males		Black/Hispanic Females	
Intercept	.271	(4.23)	.274	(2.77)	.231	(3.10)	.271	(2.76)
Married	-.013	(-1.23)	.032	(2.86)	.002	(0.09)	-.004	(-0.20)
Never married	-.034	(-2.78)	-.002	(-0.21)	-.056	(-1.95)	-.075	(-3.18)
Household head	.055	(5.68)	.034	(3.55)	.034	(1.74)	-.004	(-0.24)
Veteran	.018	(2.95)	.087	(0.77)	.034	(2.20)	.104	(0.53)
Inside SMSA	.019	(3.74)	.026	(4.56)	-.003	(-0.23)	.027	(1.82)
Schooling								
Yrs. of grade school	-.019	(-1.82)	-.015	(-.091)	-.003	(-0.31)	-.014	(-1.14)
Yrs. of high school	.034	(4.93)	.034	(3.68)	.021	(1.47)	.010	(0.60)
Yrs. of college	.057	(14.0)	.050	(11.1)	.077	(7.77)	.060	(5.65)
Yrs. of master's work	.077	(7.88)	.039	(3.52)	.088	(3.06)	.081	(2.65)
Yrs. of post-master's work	-.051	(-3.58)	-.0001	(-0.01)	-.069	(-1.56)	-.026	(-0.51)
Completed grade school	.041	(1.12)	-.052	(-0.87)	.002	(0.04)	.070	(1.27)
Completed high school	-.049	(-2.80)	-.015	(-0.69)	-.065	(-1.74)	-.017	(-0.39)
Completed college	-.052	(-3.36)	-.050	(-2.88)	-.100	(-2.36)	-.081	(-1.85)
Experience								
Firm experience previous occp.	.0116	(6.45)	.0141	(5.19)	.0108	(1.80)	.0055	(0.78)
Firm experience previous occp.^{2}	-.00034	(-5.48)	-.00037	(-3.24)	-.00027	(-1.01)	-.00020	(-0.55)
Occp. exper., prev. firm	.0173	(17.5)	.0182	(14.7)	.0120	(4.44)	.0193	(5.78)
Occp. exper., prev. firm^2	-.00044	(-12.9)	-.00043	(-9.38)	-.00023	(-2.44)	-.00057	(-4.06)
Other previous experience	-.0000	(-0.05)	-.0014	(-7.11)	-.0042	(-2.61)	-.0050	(-2.89)
Other previous experience^2	-.00007	(-3.79)	-.00003	(-0.54)	.00001	(0.36)	-.00005	(1.16)
Occp. exper., present firm	.0013	(1.61)	.0001	(0.13)	-.0033	(-1.58)	-.00019	(-0.08)
Occp. exper., present firm^2	-.00005	(-2.45)	-.00000	(-0.21)	.00004	(0.56)	.00005	(0.62)
Switched occp. within firm	-.035	(-3.86)	-.032	(-3.34)	-.014	(-0.63)	.0176	(0.77)
Government sector	-.035	(-2.98)	.023	(1.92)	-.016	(-0.66)	.046	(1.90)
Self-employed	.001	(0.10)	.023	(1.89)	.090	(3.47)	.027	(0.73)
Part-time	-.057	(-7.08)	-.065	(-9.93)	-.035	(-1.90)	-.048	(-2.87)
Occup. & indus. variables	(present)		(present)		(present)		(present)	
$\bar{R}^2$	.2658		.2729		.2732		.2437	
N	29,898		23,519		4,912		4,580	
$\bar{Y}$	.579		.550		.438		.467	

UNIVERSE: All employed persons present in the January 1983 Supplemental CPS.

NOTE: To determine the significance levels of the coefficients, see the notes to Table 5-24.

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Quite surprising is the pattern of schooling coefficients for white women, showing that the effect of college and especially master's-level work is not as great as for the other groups. It appears that higher education for white women is somewhat less job oriented. On the other hand, higher education for both minority sexes are stronger indicators of qualifying training than for whites. The previous occupation and firm experience variables are generally the strongest experience effects for all groups, but they are somewhat weaker for minority men. Contrarily, previous firm experience is less significant for minority women, but previous occupational experience is more significant. The variable representing switching occupations is significantly negative only for whites, women employed in the government sector are more likely to have qualifying training than men, and self-employment is most likely to represent qualifying training for minority men.

Table 5-26 shows linear probability regression coefficients when the dependent variables are dummies for specific types of qualifying training--in school, formal company training, or informal OJT--and the independent variables are the same combination of individual and job-descriptive variables as used in model 2 of table 5-24. School-based training is explained best, presumably because of the close correlation between the education variables and education-related skills. The differences between these types of qualifying training include that males and heads of households are much less likely to acquire these skills in school than from other sources. The result may be due to the high explanatory power of higher education in that regression, but still is somewhat at variance with the smaller schooling effects for white women in table 5-25. Although the effect of being white is less positive than average in determining presence of formal company training, the effect of being a veteran is much higher than average.

Among the education effects in table 5-26, the strongest are not surprisingly those of higher education on prior skills acquired in school. However, whereas high school and college are positive predictors of the other two types of training, graduate work is a significant negative predictor in both cases. It must be the case that jobs filled by individuals with graduate school backgrounds have very small firm-specific training components. Once again, completing college has significantly negative effects in each case, showing

TABLE 5-26

LINEAR PROBABILITY REGRESSION ESTIMATES OF TYPES OF QUALIFYING TRAINING

(t-statistics in parentheses)

Variable	Qualifying Training in School		Qualifying Training Formal Company		Qualifying Training Informal OJT	
Intercept	.172	(5.85)	.004	(1.83)	.084	(2.31)
Male	-.049	(-7.93)	-.004	(-0.88)	-.003	(-0.34)
White	.030	(6.52)	.007	(1.99)	.043	(7.55)
Hispanic	-.008	(-1.13)	-.000	(0.04)	-.019	(-2.21)
Married	.008	(1.37)	.003	(0.56)	-.011	(-1.60)
Never married	-.013	(-2.05)	-.010	(-2.06)	-.023	(-3.69)
Household head	-.003	(-0.49)	.036	(7.24)	.048	(6.30)
Veteran	-.009	(-2.12)	.016	(4.43)	-.013	(-2.42)
Inside SMSA	.008	(2.61)	.013	(5.55)	.008	(2.16)
Female household head	-.006	(-0.70)	-.026	(-3.62)	-.019	(-1.67)
Schooling						
Yrs. of grade school	-.007	(-1.52)	-.004	(-1.12)	-.009	(-1.65)
Yrs. of high school	.005	(1.15)	.008	(2.43)	.015	(3.03)
Yrs. of college	.063	(27.5)	.013	(7.04)	.022	(7.68)
Yrs. of masters work	.115	(20.1)	-.006	(-1.30)	-.015	(-2.06)
Yrs. postmaster's work	.002	(0.21)	-.036	(-5.17)	-.042	(-3.95)
Completed grade school	-.011	(-0.63)	.011	(0.74)	.030	(1.36)
Completed high school	-.023	(-2.27)	.000	(0.03)	-.009	(-0.69)
Completed college	-.028	(-3.11)	-.020	(-2.76)	-0.033	(-3.05)
Experience						
Firm experience, previous occupation	-.0024	(-2.11)	.0068	(7.32)	.0165	(11.7)
Firm experience, previous occupation^2	.00003	(0.59)	-.00017	(-4.81)	-.00045	(-8.56)
Occupational exper., previous firms	.0079	(13.3)	.0032	(6.70)	.0156	(21.4)
Occupational exper., previous firms^2	-.00022	(-10.4)	-.00010	(-5.55)	-.00037	(-14.2)
Other previous exper.	.0060	(-14.6)	-.0011	(-3.36)	.0038	(7.37)
Other previous exper.^{2}	.00009	(9.05)	-.00001	(-1.62)	-.00010	(-8.64)
Occupational exper. within firm	.0028	(5.96)	.0006	(1.58)	-.0041	(-7.03)
Occupational exper. within firm^2	-.00006	(-4.29)	-.00003	(-2.48)	.00006	(3.60)
Switched occupation within firm	-.0084	(-1.71)	-.001	(-0.22)	-.021	(-3.53)
Other previous exper, female	-.00036	(-1.28)	.0010	(5.17)	.0002	(0.71)
Government sector	-.0000	(-0.07)	-.0030	(-0.69)	-.011	(-1.41)
Self-employed	-.011	(-1.98)	-.0050	(-1.04)	-.011	(-1.68)
Part-time	-.0421	(-11.0)	-.008	(-2.54)	-.034	(-7.11)
Occup. & industry variables	(present)		(present)		(present)	
$\bar{R}^2$	.4013		.0054		.0713	
$\bar{Y}$	.285		.094		.278	

UNIVERSE: All employed persons in the January 1983 Supplemental CPS.

NOTE: To determine the significance levels of the coefficients, see the notes to Table 5-24.

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that receiving a bachelor's degree is not as indicative of having job-related prior skills as just starting college or going to a postsecondary vocational school.

The experience variables have somewhat different effects depending on the source of qualifying training. Previous firm experience predicts only the presence of formal training or informal OJT but not skills acquired in school. However, previous occupational experience is a positive indicator of all three sources of prior skills, but its effect is strongest for informal OJT. Both of these sets of results are consistent with expectations in a standard human capital framework. The effect of other (nonrelevant) previous experience is negative but rising for school-acquired skills, negative and declining for formal company training, and positive but declining for informal OJT. The first of these probably reflects depreciation through disuse, the second effect is comparatively small, and the third effect indicates some accumulation of general occupational skills even in somewhat different occupations. However, other experience for females has a positive effect on having had formal company training, possibly reflecting a carry over of secretarial and clerical skills (female-dominated professions) obtained in this manner.

The selection effect of experience on the current job shows up again in these models with this experience being positively related to school-acquired skills but negatively related to OJT skills. In other words, those coming into a job with school-acquired skills are more likely to stay with the same job, but those entering with informal OJT-related skills are likely to have shorter tenure on a specific job. This may indicate stronger commitment to using skills acquired in school because of the greater investment required and the greater likelihood that one will stay within a school-acquired profession.

In reviewing the determinants of qualifying training, a basic result was that job characteristics are stronger determinants than individual characteristics, and that those in occupations traditionally considered to be skill-intensive, such as the professional specialty and technician occupations, are more likely to have such training. Some demographic characteristics are important here; the females, veterans, whites, and those who were ever married in this sample are more trained. Years of schooling at the secondary and especially the postsecondary levels increase the probability of qualifying training, but completing those levels does not. All types of related experience have positive but declining effects on this probability. Some of these effects may be due to sample selection considerations in that only those currently employed are present in the sample. In addition, although there are some differences, the principal determinants of prior training among race-sex groups and among sources of training are generally similar.

Skill Improvement Training

Receiving skill improvement training while on the job is a result of a combination of firm and individual actions, taking place at the initiative of one or the other, or both. This can range from an employee going to night school for skills unrelated to his or her current firm or occupation to employer-directed training at skills very particular to the current firm and occupation. Modeling the incentives or reasons for receiving training depends on knowledge of the nature and purpose of the training.

For modeling purposes, it will be assumed that at least some of this training is aimed at improving skills relevant to the current job. This is almost certainly true for a majority of those in the CPS who report training--those with employer-paid schooling, formal company training, or informal OJT--and possibly true for the remainder. We will assume that there is some maximum useful skill level, S_{jk} within a given firm and occupation, and that training takes place only when $S_i < S_{jk}$, S_i once again being individual i's skill level at the time of hiring. Another necessary (and sufficient) condition for skill improvement training is that the net benefit of training be positive (and that there be some mechanism by which one party can "bribe" the other to agree, if necessary). This assumption will be stated as $T_{ijk} > 0$; the benefit level certainly is determined by some interaction of firm and individual characteristics so it is subscripted by i and j and k. Technically, $T_{ijk} > 0$ implies $S_i < S_{jk}$ if S_{jk} is a strict maximum for useful job skills. Among other things, T_{ijk} is a function of the "trainability" of individual i in occupation j.

These assumptions lead to the following specifications:

(3) $A = f(S_i, S_{jk}, T_{ijk})$

where A is a binary variable representing skill improvement training. Variables used will be similar to those used for prior training, as will be the nature of the models presented, with one exception. To help measure an individual's skill level relative to his occupation, in some models, we use a variable for actual prior training (P) and one for the gap between actual and predicted prior training ($P-\hat{P}$). As this latter variable gets larger, presumably the skill deficiency widens and the greater the need for skill improvement training. An alternative that is more arbitrary but reduces identification problems involving P is to include dummies:

$D1 = 1$ if $\hat{P} = 1$, $P \geq .5$, 0 otherwise
$D2 = 1$ if $\hat{P} = 1$, $P < .5$; 0 otherwise
$D3 = 1$ if $\hat{P} = 0$, $P \geq .5$; 0 otherwise

D_2 represents presence of more qualifying training than expected, D_3 less than expected. A further distinction between these models and the earlier ones is the effects of different types of qualifying training on skill improvement training.

Tables 5-22 and 5-23 report coefficient estimates for occupation and industry dummy variables in linear probability regressions on skill improvement training. The intercept probability for a full-time worker in a private firm with no firm experience is 0.2492, to which industry and occupation coefficients should be added to get an industry-occupation specific probability. Both sets of coefficients form patterns very similar to those in the qualifying training regressions the Spearman rank correlation coefficient between qualifying and skill improvement regression coefficients are 0.78 and 0.89 for the industry and occupation coefficients, respectively. Among different jobs, then, there is a high correlation between need for training prior to the job and receiving training at the job. Some minor exceptions to this are that college teachers, health technologists, and secretaries are relatively less likely to receive training at the job than they were to have had prior training. The same is true for those in repair and personal service and construction and chemical manufacturing industries. Relatively more likely to receive skill improvement training than qualifying training are those in the protective service or farm management or in the communications industry. The adjusted R^2 for this regression was 0.1551, whereas that for a similar regression with a reduced set of dummy variables was 0.1380, indicating that the smaller set is nearly as good. This smaller set is used in all subsequent skill improvement training regressions.

Table 5-27 contains three sets of regression estimates for skill improvement training that use individual characteristics: one with individual characteristics alone, one adding job characteristics, and a third adding some interaction effects. The first set shows that females, whites, non-Hispanics, those who were ever married, household heads, veterans, female household heads and those outside of SMSAs are more likely to receive skill improvement training, effects that are basically similar to the qualifying training results, except that the signs for inside SMSA and female household head are reversed. The negative inside SMSA sign holds up across the regressions and may be due to greater reliance on skill improvement training because of reduced availability of already trained individuals outside cities. The sex difference disappears in subsequent regressions, suggesting that any difference is due to differences in occupations, and so forth.

The school coefficients are also similar to those found in the qualifying training regressions. Years of high school, college, and master's work have progressively stronger effects on the probability of taking skill improvement training, but postmaster's work is insignificant and completing college has a negative effect. It is also true that when more job descriptive variables are included, the schooling coefficients diminish. Here, however, formal education is less likely to be the training itself, so that these results indicate a complementarity between education and skill improvement training either due to innate trainability making the "cost" of each lower or due to formal education directly reducing the "cost" of further training.

The coefficients on the experience variables show that any experience in the firm increases the likelihood of having received skill improvement training, but nonfirm experience reduces that likelihood. Whereas the first result is expected purely on the grounds of "time at risk" of receiving training, if

TABLE 5-27

SKILL IMPROVEMENT TRAINING LINEAR PROBABILITY REGRESSION COEFFICIENTS

(t-statistics in parentheses)

Variable	Model 1		Model 2		Model 3	
Intercept	.170	(4.92)	.230	(6.28)	.297	(7.75)
Male	-.045	(-6.09)	.003	(0.41)	.001	(0.11)
White	.033	(5.52)	.035	(6.07)	.035	(6.01)
Hispanic	-.034	(-3.71)	-.039	(-4.43)	-.044	(-4.94)
Married	.016	(2.25)	.009	(1.30)	.009	(1.27)
Never married	-.047	(-5.98)	-.029	(-3.73)	-.028	(-3.65)
Household head	.034	(4.43)	.014	(1.85)	.016	(2.10)
Veteran	.024	(4.40)	.013	(2.31)	.010	(1.89)
Inside SMSA	-.020	(-5.41)	-.029	(-7.91)	-.029	(-7.87)
Female household head	.021	(1.87)	.016	(1.40)	.014	(1.25)
Schooling						
Yrs. of grade school	-.010	(-1.78)	-.010	(-1.74)	-.015	(-2.62)
Yrs. of high school	.020	(3.89)	.012	(2.38)	.005	(0.97)
Yrs. of college	.064	(22.3)	.031	(11.0)	.028	(9.72)
Yrs. of master's work	.073	(10.1)	.020	(2.86)	.016	(2.29)
Yrs. of post-master's work	.002	(0.21)	-.016	(-1.48)	-.022	(-2.06)
Completed grade school	.024	(1.03)	.019	(0.85)	.022	(1.01)
Completed high school	.000	(0.02)	-.007	(-0.54)	-.003	(-0.26)
Completed college	-.065	(-5.68)	-.047	(-4.30)	-.047	(-4.25)
Experience						
Firm exper., previous occp.	.020	(17.5)	.012	(8.32)	.0054	(1.91)
Firm exper, previous occp.^{2}	-.00065	(-13.4)	-.00042	(-7.90)	-.00040	(-7.59)
Occup. exper., previous firm	-.0011	(-1.54)	-.00042	(-5.74)	-.0055	(-3.52)
Occup. exper., previous firm^2	-.00009	(-3.47)	-.00000	(-0.36)	-.00001	(-0.34)
Other previous experience	-.0041	(-8.57)	-.0053	(-10.3)	-.0049	(-9.46)
Other previous experience^2	-.00000	(-0.11)	.00001	(1.24)	.00000	(0.37)
Occup. exper. within firm	.017	(29.7)	.0130	(22.1)	.0062	(5.07)
Occup. exper., within firm^2	-.00044	(-25.7)	-.00032	(-18.6)	-.00030	(-17.2)
Switched occp. within firm	---		.011	(1.75)	.0096	(1.58)
Other previous exper., female	---		.0020	(5.70)	.0019	(5.48)
Government sector	---		.075	(9.89)	.075	(9.84)
Self-employed	---		-.065	(-9.82)	-.064	(-9.66)
Part-time	---		-.054	(-11.3)	-.055	(-11.5)
Qualifying training	---		.111	(27.4)	.111	(27.4)
Occupation & industry variables	(absent)		(present)		(present)	
Educ. x occp. exp.	---		---		.0001	(0.98)
Educ. x firm exp.	---		---		.0005	(2.67)
Educ. x firm occp. exp.	---		---		.0005	(6.31)
$\bar{R}^2$		.1126		.1765		.1771

UNIVERSE: All employed persons in the January 1983 Supplemental CPS.

NOTE: To determine the significance levels of the coefficients, see the notes to Table 5-24.

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nothing else, the latter is more unusual. It may be that previous occupational experience indicates some attachment to the occupation and hence the presence of prior occupational skills, resulting in little need for additional or firm-specific training. The negative effect of other previous experience is similar to its effect on qualifying training, but here is more fully due to its being an indicator of less occupational attachment and thus probably of a "secondary labor market" career that involves little training. Both of these negative nonfirm experience effects are considerably smaller than the positive firm experience coefficients.

Once again the pure job-descriptor variables explain more variation in skill improvement training than do the individual variables of model 1, with adjusted R^2's of 0.1380 versus 0.1126. When they are combined in model 2 the proportion of variance explained rises to 0.1765, again indicating considerable confluence of their explanatory functions.

Some other influences displayed in models 2 and 3 include that those self-employed or working part-time are much less likely to receive skill improvement training, whereas those in government or with qualifying training are much more likely to do so. The negative effect of other previous experience is smaller for females, allowing for such time to represent time out of the labor market to raise a family rather than a variable job history. Allowing education-experience interactions reveals a marked difference from the qualifying training regressions. Here it is education and firm experience variables that have complementary effects, whereas it was the previous occupational experience that was substitutable for education in the prior model. In this case, firm experience increases likelihood of having received on-the-job training more in the presence of greater education than with less education, possibly indicating on-the-job screening effects. There is also a small positive "promotion" effect of switching occupations within the firm.

We also report some partial regression results where all variables used except those relating to qualifying training are the same as in model 2.

First,

$$\begin{aligned} A_i = {} & \underset{(25.4)}{.125\ \mathrm{BEFJOB1}_i} + \underset{(26.0)}{.158\ \mathrm{BEFJOB2}_i} + \underset{(13.7)}{.055\ \mathrm{BEFJOB3}_i} + \underset{(7.27)}{.094\ \mathrm{BEFJOB4}_i} \\ & + \underset{(7.28)}{.138\ \mathrm{BEFJOB5}_i} + \underset{(3.35)}{.032\ \mathrm{BEFJOB6}_i} + \text{other variables} \end{aligned}$$

where BEFJOB1 through BEFJOB6 represent qualifying training in the form of (1) schooling, (2) formal company training, (3) informal OJT, (4) Armed Forces, (5) correspondence course and (6) other sources, and t-statistics are shown in parentheses. All have significant positive effects, but the formal company training, schooling, and correspondence course effects are the largest. Clearly, prior schooling and formal company training often provided by the current employer while the employee was in a different position within the firm, are expected to lead to continued training, but the correspondence course effect is not predicted in this context.

Secondly,

$$A_i = \underset{(16.1)}{.374\ P_i} - \underset{(-11.8)}{.271\ (P_i - P_i)} + \text{other variables}$$

where P_i is qualifying training and P_i is the predicted value of qualifying training (from a linear probability regression including the full set of industry and occupation dummies). This shows that the lower the predicted probability of having qualifying training, the smaller the chances of taking skill improvement training, and reinforces the argument that it is the job that determines training. The opposite effect on the residual or predicted training term would have argued for a strong unobserved "ability" effect on training of both types that would result in training even when not otherwise predicted.

A third regression,

$$A_i = \underset{(22.9)}{.157\ D1_i} + \underset{(15.5)}{.092\ D2_i} + \underset{(5.25)}{.038\ D3_i} + \text{other variables}$$

where D1, D2, and D3 are dummy variables described earlier, provides a slightly different picture of a similar story. A combination of actual and predicted qualifying training (D1) is most likely to lead to skill improvement training. Actual but not predicted prior training (D2) has a positive effect but one not as strong as that of D1, pointing to the importance of having the right job characteristics. The positive effect of D3 (predicted but not actual prior training) also points to the importance of the characteristics that predict training. Because D3 is negatively related to qualifying training, and qualifying and skill improvement training are positively correlated, the effect of D3 here could easily have been negative. The stronger effect of D_2 versus D3 only reflects the incomplete predictive power of the preliminary regression.

Table 5-28 presents linear probability regression estimates for skill improvement training broken out by sex and race. First, note that the percent of variation explained is remarkably similar across groups, implying that effects of unobserved factors--ability, and so forth--may be similar. Among the demographic variable effects, some differences observed are the more positive effects of current marriage and bachelorhood for minority men--the latter being somewhat surprising. Minorities also show that being head of household has little effect on skill improvement training.

Some differences among the schooling coefficients include that years of high school have a significantly positive coefficient only for white women, although the effect is nearly as strong for minority men. Years of college are significantly positive for all but minority females, but it is only for them that master's work is significant. The somewhat weaker school coefficients as compared to model 2 of table 5-27 are due to the inclusion of types of qualifying training, which are generally very strong determinants of skill improvement training. The experience variables show no significant changes in sign from the combined group results in table 5-27, although there are a few statistically insignificant differences. The negative self-employed effect is strongest for men, whereas the negative part-time effect is strongest for whites, particularly women.

Among qualifying training effects, the schooling effect is smaller for females but the OJT effect is larger. Aside from Armed Forces training, the other prior training categories have their largest effect on white females, which would suggest that there is a stronger tendency for training to be provided to women who already have skills and have demonstrated their ability to be trained.

Lastly, table 5-29 displays regression estimates using types of skill improvement training as the dependent variables. It shows that Hispanics, veterans, those inside SMSAs, and female household heads are relatively more

TABLE 5-28

LINEAR PROBABILITY REGRESSION ESTIMATES OF SKILL IMPROVEMENT TRAINING, BY RACE AND SEX

(t-statistics in parentheses)

Variable	White Males		White Females		Black/Hispanic Males		Black/Hispanic Females	
Intercept	.209	(3.17)	.145	(1.44)	.125	(1.80)	.199	(2.11)
Married	.005	(0.44)	.009	(0.82)	.044	(1.91)	-.019	(-0.93)
Never married	-.030	(-2.37)	-.021	(-1.80)	.036	(1.32)	-.042	(-1.87)
Household head	.035	(3.51)	.031	(3.13)	.006	(0.32)	-.006	(-0.39)
Veteran	.011	(1.72)	.101	(0.88)	.032	(2.14)	-.281	(-1.49)
Inside SMSA	-.032	(-6.01)	-.023	(-3.94)	-.035	(-2.65)	-.050	(-3.55)
Schooling								
Yr. of grade school	-.001	(-0.05)	.006	(0.38)	-.006	(-0.76)	-.018	(-1.50)
Yrs. of high school	.006	(0.87)	.020	(2.08)	.019	(1.41)	.014	(0.89)
Yrs. of college	.029	(6.89)	.021	(4.57)	.037	(3.90)	.007	(0.64)
Yrs. of master's work	.016	(1.58)	.080	(0.69)	.025	(0.93)	.075	(2.56)
Yrs. of post-master's work	-.018	(-1.20)	.013	(0.70)	-.040	(-0.97)	-.099	(-2.03)
Completed grade school	.039	(1.04)	-.039	(-0.64)	-.019	(-0.47)	.054	(1.02)
Completed high school	-.004	(-0.20)	-.013	(-0.62)	-.029	(-0.81)	-.008	(-0.19)
Completed college	-.051	(-3.20)	-.037	(-2.11)	-.047	(-1.19)	-.036	(-0.87)
Experience								
Firm exp., previous occp.	.0083	(4.47)	.0157	(5.65)	.0198	(3.52)	.0050	(0.75)
Firm exp., previous occp.^{2}	-.00031	(-4.88)	-.00063	(-5.41)	-.00069	(-2.78)	-.00011	(-0.32)
Occp. exp, previous firm	-.0076	(-7.36)	-.0015	(-1.15)	-.0061	(-2.40)	.0031	(0.96)
Occp. exp, previous firm^2	.00007	(1.95)	-.00008	(-1.62)	.00009	(0.99)	-.00009	(-0.68)
Other previous experience	-.0063	(-8.59)	-.0015	(-1.94)	-.0040	(-2.62)	-.0015	(-0.90)
Other previous experience^2	.00004	(2.15)	-.00004	(-1.82)	.00004	(1.18)	-.00003	(-0.85)
Occp. exper. within firm	.0113	(14.1)	.0165	(15.0)	.0096	(4.82)	.0150	(6.32)
Occp. exper. within firm^2	-.00028	(-12.8)	-.00043	(-11.7)	-.00021	(-3.47)	-.00031	(-3.94)
Switched occup. within firm	.014	(1.51)	.010	(1.02)	-.024	(-1.22)	.031	(1.41)
Govt. sector	.081	(6.70)	.068	(5.60)	.080	(3.56)	.058	(2.50)
Self employed	-.081	(-9.40)	-.026	(-2.07)	-.085	(-3.47)	-.061	(-1.69)
Part-time	-.047	(-5.64)	-.059	(-8.78)	-.032	(-1.90)	-.034	(-2.10)
Qualifying training in school	.140	(18.5)	.103	(13.6)	.139	(7.15)	.094	(5.21)
Qualifying training--formal company	.141	(17.1)	.176	(16.0)	.162	(7.71)	.120	(4.98)
Qualifying training--informal OJT	.046	(8.14)	.064	(9.48)	.045	(3.26)	.079	(5.15)
Qualifying training--armed forces	.103	(7.30)	-.095	(-1.33)	.097	(2.50)	-.204	(-1.49)
Qualifying training--corres. course	.126	(5.35)	.187	(4.86)	.141	(2.01)	.066	(0.61)
Qualifying training--other sources	.026	(2.14)	.049	(2.57)	.029	(0.88)	.021	(0.48)
Occup. & industry variables	(present)		(present)		(present)		(present)	
$\bar{R}^2$	.1895		.1885		.1935		.1787	
N	29,898		23,519		4,912		4,580	
$\bar{Y}$	.373		.357		.264		.301	

UNIVERSE: All employed persons in the January 1983 Supplemental CPS in the appropriate race/sex category.

NOTE: To determine the significance levels of the coefficients, see the notes to Table 23.

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likely to be in the schooling group, those married or heads of households are more likely to be in the formal company training group, whereas whites are relatively less likely to be in the informal OJT groups. The schooling variables show that college and master's work are strongly related to skill improvement schooling; indeed they may be the same thing. Only college is a strong positive determinant of formal company training, whereas postmaster's work has a very strong negative effect on this type of training. No schooling variables are significant positive predictors of informal OJT, but graduate work makes it less likely.

The experience variables have the same sign pattern across different skill improvement training types, although there are some differences in the magnitude of the effects. Notably, previous firm experience is most positive for formal company training, whereas previous occupational experience is most negative for informal OJT. The former indicates some relationship between firm attachment and formal company training, whereas the latter probably represents a reduced need for informal OJT. The effect of current job tenure is most positive on skill improvement schooling, possibly indicating that such schooling is received or undertaken by the more favored or more ambitious employees. The occupational switch variable is strongly positive only in predicting informal OJT. Although this effect is not surprising, one might have expected a positive effect on formal company training as well. The negative effect of other previous experience is mitigated least for qualifying schooling, indicating that the schooling path is least likely to be taken by females returning to work. However, the self-employed are relatively more likely to go back to school than to take any other kind of training.

People strongly tend to receive the same kind of training while at the job as they received prior to the job, as evidenced by the pattern of qualifying training coefficients. The strength of these correlations is a little surprising, because one might expect people to progress from one kind of training to another. However, it is evident that people either identify with a certain type of training or stay in occupational channels that make use of a particular training style.

TABLE 5-29

LINEAR PROBABILITY REGRESSION ESTIMATES OF TYPES OF SKILL IMPROVEMENT TRAINING

(t-statistics in parentheses)

Variables	At-Job Schooling		At-Job Formal Company Training		At-Job Informal OJT	
Intercept	.054	(2.19)	.089	(3.60)	.127	(4.38)
Male	-.004	(-0.87)	.003	(0.56)	.004	(0.60)
White	.020	(5.11)	.021	(5.36)	-.001	(-0.27)
Hispanic	-.007	(-1.13)	-.023	(-3.78)	-.017	(-2.44)
Married	-.002	(-0.42)	.015	(3.04)	-.006	(-1.15)
Never married	-.013	(-2.66)	-.013	(-2.44)	-.008	(-1.28)
Household head	-.008	(-1.67)	.022	(4.22)	-.000	(-0.03)
Veteran	.009	(2.29)	-.001	(-0.27)	-.002	(-0.52)
Inside SMSA	-.002	(-0.63)	-.015	(-5.97)	-.013	(-4.48)
Female household head	.022	(2.99)	-.001	(-0.07)	-.001	(-0.11)
Schooling						
Yrs. of grade school	-.004	(-1.16)	-.002	(-0.65)	-.003	(-0.78)
Yrs. of high school	.002	(0.55)	.004	(1.22)	.005	(1.15)
Yrs. of college	.017	(8.64)	.011	(5.78)	.004	(1.54)
Yrs. of master's work	.038	(8.01)	-.001	(-0.24)	-.015	(-2.68)
Yrs. of post-master's work	-.003	(-0.48)	-.032	(-4.44)	-.018	(-2.08)
Completed grade school	.000	(0.00)	-.012	(-0.82)	.021	(1.17)
Completed high school	-.009	(-1.05)	-.004	(-0.50)	.000	(0.05)
Completed college	-.051	(-6.92)	.004	(0.50)	.004	(0.51)
Experience						
Firm experience, previous occupation	.0039	(4.10)	.0090	(9.37)	.0026	(2.33)
Firm experience, previous occupation^2	-.00014	(-3.97)	-.00026	(-7.27)	-.00012	(-2.95)
Occup. experience, previous firm	-.0001	(-0.17)	-.0025	(-4.91)	-.0050	(-8.55)
Occup. experience, previous firm^2	-.00003	(-1.92)	.00002	(1.21)	.00008	(3.99)
Other previous exper.	-.0031	(-8.85)	-.0022	(-6.20)	-.0017	(-4.08)
Other previous exper.^{2}	.00003	(4.26)	.00001	(1.22)	-.00001	(-0.55)
Other experience within firm	.0075	(19.0)	.0044	(11.0)	.0025	(5.29)
Other experience within firm^2	-.00018	(-15.5)	-.00011	(-9.52)	-.00006	(-4.39)
Switched occupation within firm	-.002	(-0.45)	.000	(0.10)	.017	(3.35)
Other previous experience, female	.0003	(1.39)	.0010	(4.61)	.0009	(3.35)
Government sector	.033	(6.42)	.037	(7.19)	.039	(6.39)
Self-employed	-.005	(-1.20)	-.054	(-12.0)	-.060	(-11.4)
Part-time	-.017	(-5.19)	-.018	(-5.67)	-.024	(-6.34)
Occupation & industry variables	(present)		(present)		(present)	
Prior training--in school	.108	(32.4)	.047	(13.9)	-.012	(-2.99)
Prior training--formal company	.030	(7.24)	.183	(43.9)	.011	(2.34)
Prior training--informal OJT	.013	(4.94)	.016	(5.78)	.047	(14.8)
Prior training--armed forces	.037	(4.25)	.082	(9.24)	.020	(1.95)
Prior training--corres. course	.033	(2.59)	.054	(4.16)	.065	(4.25)
Prior training--other sources	.013	(2.04)	.006	(0.96)	.027	(3.59)
$\bar{R}^2$	.1772		.1265		.0311	
$\bar{Y}$	.116		.112		.143	

UNIVERSE: All employed individuals in Supplemental CPS sample.

NOTE: To determine significance levels of the coefficients, see the note to Table 23.

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The principal conclusion from examination of the determinants of qualifying and skill improvement training is that they are very similar and are highly correlated with each other, both generally and within subcategories. Although industry and occupation seem to be the strongest determinants of training, demographic, education, and experience are also significantly related to these phenomena.

5.4 Training and Earnings

Estimation Considerations

As related earlier, training should take place only if its expected net benefit is positive. The direct benefit should be higher productivity, which should translate to greater profits for the employer and higher pay and nonpecuniary benefits for the employee. Here, the only effect of training that can be directly observed is that which influences observed earnings.

The proportion of benefits due to training that accrues to the employee depends on a number of factors. For example, if all potential employees are equally skilled and equally trainable, and all training is firm-specific, the only effect of training on the employee would be a slight increase in earnings after training in order to induce the employee not to leave the firm. Even this could be offset by a slight decrease in earnings during the training period, and we may see no net effect of training. On the other hand, if all training were completely general and individuals were heterogeneous in trainability and innate productivity, and the latter two were positively correlated, then all benefits of training would accrue to the individual, and the observed earnings of trainees would be higher due not only to training but also due to higher innate productivity (assuming the more trainable get more training). Hence the observed effect of training on earnings depends on the type of training, unobserved worker heterogeneity, and the proportion of benefits that are pecuniary, as well as a number of other factors such as the correlation of observed training and unobserved training (learning-by-doing) and a variety of principal-agent considerations that have recently been pursued in the literature (e.g., Lazear 1981, Hashimoto 1981).

With these factors under consideration, we begin with the standard log earnings specification for estimation purposes:

$$\ln Y_i(t) = a + \underline{b}'\underline{X}_i(t) + \sum_{k=1}^{m} r_{sk}S_{ik}(t) + \sum_{j=1}^{n} r_{Tj}T_{ij}(t) + \ln[1-I(t)] + u_i(t)$$

where

$Y_i(t)$ = observed earnings of individual i at time t,
$\underline{X}_i(t)$ = vector of individual characteristics,
r_{sk} = rate of return to a year of schooling of type K,
s_{ik} = years of schooling of type K,
m = number of school types,
r_{Tj} = rate of return to training of type j,
$T_{ij}(t)$ = equivalent years of training of type j at time t,
n = number of training types, and
$I(t)$ = proportion of time in training at time t.*

Since much training occurs via learning by doing and is not directly observable, the standard assumption is that such training declines linearly with experience, and hence accumulated training can be represented by a quadratic function of experience. Since different types of experience may have different degrees of relevance to the current job, we respecify the equation

$$\ln Y_i(t) = a + \underline{b}'\underline{X}\,(t) + \sum_{k=1}^{m} r_{sk}S_{ik}(t) + \sum_{l=1}^{q} (c_l E_{il}(t) + d_l E_{il}^2(t)) +$$
$$\sum_{j=1}^{n'} r_{Tj}T_{ij}(t) + \ln\,[1-I(t)] + u_i(t)$$

where E_{il} is years of experience of type l and c_l and d_l are functions of the rates of return of the unobserved training, initial human capital, and the parameters of the training time function, and there are still n' types of directly observable training. The investment time I(t) is not directly observed and here will be accounted for in two ways: (1) if it is a declining function of experience, it will be represented by E_{il} and $E^2{}_{il}$, hence changing their coefficients somewhat; and (2) a dummy for having changed jobs in the past year will capture any first-year deviations from the assumed linearity of investment time.

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*This specification assumes that nonpecuniary returns are a constant proportion of total returns accruing to the individual.

Observable training is generally not measured in equivalent years, and thus, to the extent that the amount of training is not directly measurable the resulting estimated rate of return will be weighted by the average amount of training. Hence a dummy variable representing a month-long training course will have a much smaller estimated rate of return than that for a year of schooling, even if the two types of investments are equally skill-producing per unit of time.

In addition, this specification assumes a constant rate of return to training over individuals and over time, in contrast to some of the implications of the screening, shirking, and implicit contract literature. However, by interacting training with variables like education and experience we can allow for variations in rates of return and make comments on the reasons for those variations.

Estimation Results

The estimates of returns to training and other results will be presented in increasing degrees of detail about the type of training. Following those will be an examination of the interaction effects of training with formal schooling and experience, as well as a breakdown of returns to training for 10 major occupational groups. In all cases, the dependent variable is the natural logarithm of weekly earnings reported in the survey week.

Table 5-30 presents a full set of regression coefficients for three specifications: one with individual characteristics but not training variable, for comparison purposes, one with individual characteristics and basic training variables, and one which adds occupation and industry variables as well.

Focusing on the training variables first, we see that in model 2, those reporting having needed skills to qualify for their job had earnings 16.0 percent higher than those who did not, whereas those reporting having taken training to improve their skills while at their current job have earnings 12.9 percent higher than those who did not. However, there is some reduncancy in their effects, as those reporting both types of training had earnings only 22.2 percent higher than those who reported neither. The inclusion of occupation and industry dummy variables in model 3 reduces the qualifying training

TABLE 5-30

Log Earnings Regression Coefficients with Simple Training Effects

(t-statistics in parentheses)

Variable	Model 1		Model 2		Model 3	
Intercept	4.946	(68.3)	4.911	(69.0)	5.062	(69.9)
Male	.141	(7.68)	.163	(9.04)	.141	(8.00)
White	.080	(6.53)	.064	(5.27)	.034	(3.03)
Hispanic	-.092	(-5.02)	-.079	(-4.39)	-.055	(-3.23)
Married	.073	(4.54)	.067	(4.26)	.050	(3.38)
Never married	-.066	(-3.86)	-.060	(-3.58)	-.058	(-3.72)
Household head	.213	(12.0)	.194	(11.1)	.151	(9.21)
Govt. sector	.000	(0.02)	-.020	(-1.88)	-.002	(-0.17)
Veteran	.051	(4.23)	.047	(3.98)	.030	(2.69)
Inside SMSA	.106	(12.9)	.103	(12.7)	.091	(11.9)
Female household head	-.069	(-2.65)	-.059	(-2.35)	-.038	(-1.42)
Schooling						
# years, 1-8	-.031	(-2.65)	-.031	(-2.64)	-.030	(-2.76)
# years, 9-12	.040	(3.10)	.034	(2.69)	.029	(2.51)
# years, 13-16	.067	(10.4)	.051	(7.95)	.035	(5.81)
# years, 17-18	.109	(6.94)	.093	(6.02)	.093	(6.36)
# years, 19+	.042	(1.79)	.043	(1.87)	.053	(2.46)
Completed grade school	.125	(2.42)	.119	(2.34)	.107	(2.26)
Completed high school	.039	(1.29)	.035	(1.18)	.029	(1.04)
Completed college	-.014	(-0.56)	-.00043	(-0.01)	-.023	(-0.99)
Experience						
Occupational exper.	.0187	(10.5)	.0153	(8.66)	.0157	(9.51)
Occupational exper.^{2}	-.00047	(-6.98)	-.00037	(-5.54)	-.00038	(-6.07)
Firm experience	.0421	(12.6)	.0381	(11.6)	.0305	(9.93)
Firm experience^2	-.00101	(-7.77)	-.00087	(-6.85)	-.00069	(-5.80)
Occupational exper. within firm	.0268	(16.3)	.0255	(15.7)	.0226	(14.8)
Occupational exper. within firm^2	-.00058	(-10.0)	-.00054	(-9.51)	-.00049	(-9.18)
Switched occupation within firm	-.012	(-0.79)	-.012	(-0.79)	-.0194	(-1.38)
Other experience	.0065	(5.16)	.0068	(5.48)	.0048	(4.17)
Other experience^2	-.00023	(-6.91)	-.00021	(-6.63)	-.00015	(-4.99)
Other exp. - female	-.0024	(-2.74)	-.0023	(-4.51)	-.0014	(-1.73)
Changed jobs past year	-.076	(-4.89)	-.069	(-4.51)	-.053	(-3.68)
Occup. & industry	(absent)		(absent)		(present)	
Qualifying training	---	---	.160	(14.9)	.105	(10.2)
Skill improvement training	---	---	.129	(9.10)	.088	(6.61)
Training interaction	---	---	-.067	(-3.86)	-.035	(-2.17)
R^2	.4133		.4348		.5115	

UNIVERSE: All full-time workers who report earnings in the January 1983 Supplemental CPS; N = 10,495.

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effect to 10.5 percent, the skill improvement training effect to 8.8 percent, and the combined effect to 15.8 percent. The higher estimates without the job characteristic variables is due to the general correlation of training with higher paying occupations, so the training variables pick up this higher pay, even though it may not be due to training. On the other hand, the occupation variables may pick up differences in type and intensity of training, so that without further detail in the training variables it is difficult to say which model more truly represents the average training effect.

Before moving on to models with more precise training variables, it is interesting to note how inclusion of training affects other variables in the model. Being male has a larger effect on earnings when training is accounted for, because more females have training, but this change disappears when occupation and industry are included. Most other demographic variables have a smaller effect when training is included because they are positively correlated with training. High school-, college-, and master-level education effects drop somewhat when training is included, although not as much as one might expect given that qualifying training includes job-relevant schooling. This leads to the conclusion that much of the schooling effect on earnings is due to its production of general human capital or its correlation with ability. It is also interesting that although the earnings effects of high school and college fall when job variables are included, the effect of post-graduate work stays constant or rises. Finally, experience effects fall slightly when training variables are included, possibly implying that returns to experience are greater for those with training. More will be said about this later.

Tables 5-31 and 5-32 present estimated training effects on log earnings for more detailed levels of training, when all other explanatory variables included in model 3 are present. The first row and column are the direct training effects, whereas the rest of the table displays interactions between two types of training. The largest returns are to skill improvement schooling (10.4 percent) and formal company training (10.8 percent) while on the job. Next at 9.8 percent and 9.7 percent are qualifying formal training and informal OJT, respectively. Those who reported informal OJT or other training on the job also had significantly higher earnings. Two-thirds of the interaction

TABLE 5-31

LOG EARNINGS REGRESSION COEFFICIENTS FOR TYPES OF TRAINING WITH BETWEEN-TYPE INTERACTIONS

(t-statistics in parentheses)

Qualifying Training	Skill Improvement Training				
	Intercept	Schooling	Formal Company Training	Informal OJT	Other
Intercept		.104 (4.67)	.108 (5.75)	.046 (3.16)	.069 (1.91)
Schooling	.063 (4.55)	-.032 (-1.32)	.003 (0.14)	-.008 (0.35)	-.032 (-0.83)
Formal Company Training	.098 (5.14)	-.041 (-1.25)	-.053 (-1.97)	.011 (0.33)	-.044 (-0.83)
Informal OJT	.097 (8.39)	-.055 (-2.20)	-.029 (-1.24)	-0.64 (-2.97)	.019 (0.50)
Armed Forces	.048 (1.20)	.028 (0.45)	.078 (1.40)	-.050 (-0.81)	-.027 (-0.33)
Correspondence Course	-.025 (-0.27)	.159 (1.60)	-.045 (-0.46)	-.065 (-0.64)	.023 (0.22)
Other	.057 (1.52)	-.086 (-1.13)	-.085 (-1.15)	.079 (1.25)	-.105 (-1.18)

TABLE 5-32

LOG EARNINGS REGRESSION COEFFICIENTS FOR WITHIN-TYPE TRAINING INTERACTIONS

(t-statistics in parentheses)

Qualifying Training	Skill Improvement Training					
	Schooling	Formal Company Training	Informal OJT	Corres. Course	Armed Forces	Other
Schooling	---	-.022 (-0.72)	.004 (.013)	---	---	-.027 (-0.48)
Formal Company Training	-.021 (-0.73)	---	.008 (0.27)	---	---	.017 (0.27)
Informal OJT	-.013 (-0.68)	.012 (0.44)	---	---	---	-.000 (-0.01)
Correspondence Course	-.115 (-2.14)	-.009 (-0.14)	-.030 (-0.61)	---	---	---
Armed Forces	-.178 (-2.11)	.107 (1.10)	-.053 (-0.59)	.031 (0.28)	---	---
Other	-.004 (-0.07)	.053 (0.70)	-.112 (-2.14)	-.123 (-0.90)	.156 (1.19)	---

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effects were negative, and most significant were those between formal company training prior to and on the job (-5.3 percent), informal OJT prior to and on the job (-6.4 percent), and qualifying informal OJT with skill improvement schooling (-5.5 percent). Many of the other interactions, both negative and positive, are of similar sizes, but the effects are not statistically significant because of the small number of people reporting those combinations. In general, these results demonstrate that some skill training is important for higher earnings but that there is a decreasing marginal effect of added training, especially when it is similar to that which one has already had. The smaller effects of the school training are due to the fact that general education has already been controlled for.

Interactions within qualifying training types and skill improvement training types are shown in table 5-32, with the qualifying training interactions below the diagonal and the skill improvement interactions above the diagonal. These are from the same regression as the results in table 5-31, so together with those results, it should be possible to calculate the net training effect on earnings for an individual with any combination of training types (ignoring three-way interaction effects, and so forth). Within qualifying training types, the most significant interactions are between schooling and correspondence courses (-11.5 percent) or Armed Forces training (-17.8 percent) and between informal OJT and other training (-11.2 percent). None of the skill improvement interactions are either large or significant.

Table 5-33 presents earnings effects of yet more detailed characteristics. Those receiving training through school or formal company programs gave information on features of the training, and variables representing those features were included in a log earnings equation that also controlled for all variables used in model 3, as well as the four other qualifying training categories two other skill improvement training categories, and all interactions. Although many of the coefficients shown are not significant, reducing the number of variables and interactions in the regression to avoid multicollinearity did not generally make a difference.

What we find is that, among schooling types, only training at 4-year colleges or more has a significantly higher payoff than equivalent non-job relevant schooling, and high school vocational programs are significantly worse.

TABLE 5-33

LOG EARNINGS REGRESSION COEFFICIENTS FOR DETAILED TRAINING CHARACTERISTICS

(t-statistics in parentheses)

Variables	Qualifying Schooling	Qualifying Formal Company	Skill Improvement Schooling	Skill Improvement Formal Company
Intercept	---	.094 (2.01)	---	.102 (3.04)
High School Vocational	-.047 (-1.98)		-.009 (-0.13)	---
Private Postsecondary Vocational	.036 (1.24)	---	.021 (0.49)	---
Public Postsecondary Vocational	.047 (1.53)	---	-.033 (-0.76)	---
Junior or Community College or Technical Institute	-.006 (-0.28)	---	.010 (0.32)	---
4-year College or University	.047 (1.91)	---	.011 (0.35)	---
Employer Paid	-.014 (-0.54)	---	.050 (2.33)	---
CETA-Type Program	-.051 (-1.37)	.015 (0.23)	.089 (1.74)	-.104 (-1.89)
Length in Quarters	.000 (0.01)	.004 (0.70)	.001 (0.26)	-.011 (-1.56)
Completed	.048 (2.36)	-.069 (-1.58)	.037 (1.61)	.011 (0.37)
Number of Courses	.003 (0.69)	.005 (1.06)	.004 (0.84)	.002 (0.53)
Away from Job	---	-.034 (-1.46)	---	.009 (0.44)
Apprenticeship	---	.079 (2.54)	---	-.005 (-0.11)
By Current Employer	---	.038 (0.97)	---	---
By Former Employer	---	.066 (1.50)	---	---

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This may be partly a sorting phenomenon, but controlling for occupation and industry should have reduced this problem. For qualifying schooling, completing the program has a significantly positive (4.8 percent) effect, being part of a CETA-type program has a negative but insignificant (-5.1 percent) effect, and no other features have large effects. For qualifying formal training, the basic effect is slightly smaller than before (9.4 percent), but if it was a apprenticeship program, this effect is increased significantly by 7.9 percent. The return is also greater if the formal training was provided by a current or former employer and smaller if it was completed or was held away from the job.

For skill improvement schooling, the major positive features are employer paid (5.0 percent), CETA-type program (8.9 percent), and completion (3.7 percent). The direction of the employer-paid effect here is contrary to expectations in a usual training model and is probably a selection effect--employers encourage good employees to get more schooling. For skill improvement formal training, the basic effect is still large (10.2 percent) but the apprenticeship effect is very small, which is not unusual since this training is most likely employer paid, and a selection effect is less likely here. In this case the CETA effect is large enough (-10.4 percent) to erase the basic training effect. The opposite effects of the CETA variable in the skill improvement training categories are surprising.

Table 5-34 shows further results for features of training at school. For each of the five types of school, dummy variables were created for five features of the schooling, which were used in log earnings regressions with all demographic, job characteristics, and training variables, including interactions. Unfortunately, here small sample sizes result in large standard errors and small t-statistics. Few consistent patterns are discernible among these results. However, qualifying schooling at a 4-year college or university that is completed shows a significantly higher return then non-job-relevant schooling, unless the employer pays for it. Some of the CETA effects are large enough to be significant, but the signs of the effects vary.

Training effects for sex-race subgroups are shown in table 5-35. It is notable that the qualifying schooling effect is very small for white females, most likely due to a difference in average type of schooling. The qualifying

TABLE 5-34

LOG EARNINGS REGRESSION COEFFICIENTS FOR FEATURES OF TRAINING AT SCHOOL

(t-statistics in parentheses)

Feature	High School Program	Private Post-secondary Vocational Program	Public Post-secondary Vocational Program	Junior or Community College	4-Year College or University
Qualifying Training					
Employer paid	.080	.095	.071	.008	-.102
	(0.98)	(1.21)	(0.91)	(0.16)	(-2.67)
Completed	.091	-.046	.052	.063	.052
	(1.35)	(-0.61)	(0.64)	(1.34)	(1.71)
CETA-type	-.093	-.056	.024	-.078	.012
	(-0.96)	(-0.55)	(0.22)	(-1.06)	(0.20)
2-3 quarters	-.033	.076	-.030	-.060	-.008
	(-0.44)	(1.04)	(-0.34)	(-0.91)	(-0.12)
4+ quarters	-.052	.168	-.024	-.016	-.033
	(-0.75)	(2.40)	(-0.30)	(-0.26)	(-0.69)
Intercept	-.048	.000	.035	.005	.088
	(-0.69)	(0.00)	(0.39)	(0.07)	(1.94)
Skill Improvement Training					
Employer paid	.026	.079	.069	-.001	.026
	(0.15)	(1.01)	(0.85)	(-0.02)	(0.85)
Completed	-.015	.008	-.055	.013	.013
	(-0.54)	(0.08)	(-0.48)	(0.28)	(0.38)
CETA-type	-.482	-.229	.361	.167	.057
	(-1.12)	(-1.18)	(2.43)	(1.74)	(0.75)
2-3 quarters	.066	.057	-.008	.002	.050
	(0.39)	(0.59)	(-0.09)	(0.03)	(1.21)
4+ quarters	.202	.085	.159	-.073	.032
	(1.07)	(0.84)	(1.17)	(-1.43)	(0.87)
Intercept	.042	.006	.001	.074	.023
	(0.22)	(0.05)	(0.01)	(1.24)	(0.47)

schooling and formal company training returns are highest for minority males, but the informal OJT effect is smallest for the same group. Returns to other types of qualifying training are generally more variable and less significant because of small sample sizes. For skill improvement training types, returns to schooling are much higher for minority males, as are returns to other training. The return to informal OJT is largest and only significant for white males, whereas returns to formal company training are similar for all groups but statistically significant only for the white groups. Overall, returns to training seem to be fairly similar across these groups, and reveal only a few major differences.

Training and schooling. There are some training-schooling interaction effects that are yet to be discussed. One is that the length of job-relevant schooling at 4-year colleges or universities is not adequately measured by the questions asked, the highest category being 52 weeks or more. Hence, the estimate reported is not a good measure of the returns to such schooling. The second problem is that those with greater ability may have higher returns to training, but the best available proxy for ability may be years of education. In an attempt to measure both of these phenomena, a log earnings regression containing all demographic, training (as in table 5-33) and job interaction variables, as well as the interaction effects shown in table 5-36, was run.

Immediately, we see that the returns to the 4-years in college and the first 2 years of postgraduate work accrue whether the education is considered job-relevant or not (compare schooling intercepts to those in model 3 in table 5-30, and note the only slightly smaller coefficients here). However, years of postmaster's work seem to pay off only if they are job-relevant and taken prior to the current job. Also, there is a large (9.6 percent) but not statistically significant effect of receiving university-level schooling while at the job that does not depend on the years of schooling involved, although it is negated if the work is at the postmaster's level. Since there are no part-time workers in the sample, the skill improvement students most likely went or are going to night school, and so, the large intercept may represent an "ambitious" or "hard worker" effect.

TABLE 5-35

LOG EARNINGS REGRESSION COEFFICIENTS FOR TYPES OF TRAINING BY SEX AND RACE

(t-statistics in parentheses)

Feature	White Males	White Females	Black/ Hispanic Males	Black/ Hispanic Females
Qualifying training				
Schooling	.093 (4.11)	.011 (0.52)	.160 (2.95)	.083 (1.86)
Formal company training	.104 (3.93)	.051 (1.48)	.178 (2.45)	.118 (1.79)
Informal OJT	.106 (6.44)	.092 (4.50)	.065 (1.71)	.100 (2.55)
Armed Forces	.048 (1.04)	.529 (1.43)	.203 (1.82)	-.224 (-0.59)
Correspondence course	-.056 (-0.50)	-.071 (-0.32)	-.803 (-1.51)	.483 (1.17)
Other	.072 (1.46)	-.136 (-1.42)	.172 (1.43)	.378 (3.11)
Skill Improvement Training				
Schooling	.091 (2.87)	.093 (2.42)	.238 (3.02)	.077 (0.87)
Formal company training	.107 (4.11)	.088 (2.69)	.077 (1.05)	.105 (1.33)
Informal OJT	.079 (3.66)	-.003 (-0.11)	.063 (1.40)	.044 (0.90)
Other	.0725 (1.42)	.030 (0.48)	.276 (1.89)	.032 (0.21)
N	5096	3508	1039	851

The coefficients in the lower right-hand corner of table 5-36 are general education-training interactions and possibly a rudimentary indication of the effect of ability on training. Having controlled for more specific interactions, the significantly positive effect of the qualifying training-education variable suggests that either education enhances trainability, greater ability enhances the return to training, or those with more education receive more or better training in ways that are unmeasured here.

Training and experience. Another feature of training is that the return may not be constant over one's lifetime. This may be true for several reasons. Training may enhance the return to other forms of human capital, such as learning-by-doing or firm-specific human capital that accumulates with experience. It is also possible that those who receive training are generally those with more ability who would naturally have earnings growth with experience greater than those of less ability. Both of these factors would suggest positive training-experience interactions. On the other hand, qualifying training may be used as a screening device for employers. Those without qualifying training, being unproven, may receive lower earnings initially, with the promise of fast earnings growth if they prove themselves. A more detailed argument to this effect is given by Riley (1979), which suggests a flatter earnings profile for those with prior training if screening is a factor. For skill improvement training, the slope of the earnings profile ought to depend on the amount of general versus firm-specific training, with more general training resulting in lower initial earnings and a steeper slope. Factors such as on-the-job screening by training or self-selection incentives may also work to steepen the earnings profile.

To examine these effects, the interactions of six types of training with experience in the same occupation at the same firm are entered in a log earnings regression including a complete set of other variables, the same as those used for the regression shown in table 5-33. The results are seen in table 5-37. The significant results are that returns to qualifying formal company training fall .47 percent with each year of experience, whereas the returns to skill improvement schooling rise 0.48 percent with each year of experience. The first result strongly suggests a screening effect, where presence of such

TABLE 5-36

LOG EARNINGS REGRESSION COEFFICIENTS FOR TRAINING--EDUCATION INTERACTIONS

(t-statistics in parentheses)

Variable	Intercept	Years of College	Years of Master's Work	Years of Doctoral Work	Total Years of Education
Intercept	---	.029 (4.67)	.087 (3.96)	.001 (0.02)	---
Qualifying Training at 4-Year College or University	-.022 (-0.31)	.014 (0.64)	-.020 (-0.66)	.103 (1.95)	---
Skill Improvement Training at 4-Year College or University	.096 (1.28)	-.025 (-1.03)	.005 (0.15)	-.102 (-2.14)	
Qualifying Training of Any Type	---	---	---	---	.0035 (2.07)
Skill Improvement Training of Any Type	---	---	---	---	.0027 (1.49)

TABLE 5-37

LOG EARNINGS REGRESSION COEFFICIENTS FOR TRAINING--EXPERIENCE INTERACTIONS

(t-statistics in parentheses)

Training type	Intercept	Interaction
Qualifying Schooling	---	-.0011 (-0.90)
Qualifying Formal Company Training	.115 (2.46)	-.0047 (-2.62)
Qualifying Informal OJT	.096 (7.24)	.0005 (0.42)
Skill Improvement Schooling	---	.0048 (2.92)
Skill Improvement Formal Company Training	.102 (2.98)	.0002 (0.14)
Skill Improvement Informal OJT	.056 (3.25)	-.0019 (-1.27)

training gives the employer a strong indication of the skill level (especially since much of this training was provided by the current employer while the employer was in a different position at the firm). The second result is consistent with standard human capital theory, in that training at school is primarily general training, so that the employee "pays" the costs during the training period in the firm of lower wages but reaps the benefits later on. The somewhat negative effect of the skill improvement informal OJT interaction suggests that a major portion but not all of this OJT is firm-specific training "paid for" by the firm. It should be noted that the intercepts change (versus table 5-31 or 5-33) in the expected directions, i.e., upwards if the interaction effect is negative, and vice versa.

Training and occupation. Here we examine whether returns to training differ over some major occupational categories. Reasons for such variation would be unmeasured differences in quantity and quality of training, some differences in the amount of screening necessary, and various institutional differences across occupations. Table 5-38 presents estimates of returns to schooling, formal company training and informal OJT for both qualifying and skill improvement training for 10 occupational categories. The qualifying training type coefficients are listed first, and the log earnings regression otherwise controls for all variables present in the regression for table 5-34, which includes detail on schooling and formal company training and all interactions.

There are no significant differences in returns to qualifying schooling across occupations, suggesting that the features of schooling explain most of the variation. Those in transportation and material moving, service and farming, and forestry and fisheries have the highest returns to skill improvement schooling, although not all are statistically significant due partly to small sample sizes. These results probably indicate significant heterogeneity within these occupations.

Farming, transportation, sales, clerica,l and laborers all have returns to qualifying formal company training above 10 percent although not all are statistically significant. Managerment and executive and technical occupations have the lowest returns here, both under 5.0 percent. For skill informal formal company training, laborers, services, professional specialists, and precision craftsworkers have returns over 10 percent, whereas technicians,

TABLE 5-38

LOG EARNINGS REGRESSION COEFFICIENTS FOR TRAINING--OCCUPATION INTERACTIONS

(t-statistics in parentheses)

Occupation	Intercept	Schooling	Formal Company Training	Informal OJT
Managerial and Executive	.272 (9.42)	-.030 (-0.76)	.044 (0.78)	.143 (5.81)
		.047 (1.07)	.093 (2.23)	.070 (2.15)
Professional Specialty	.248 (6.62)	-.025 (-0.57)	.085 (1.41)	.068 (2.24)
		.021 (0.48)	.107 (2.36)	.011 (0.30)
Technical	.194 (4.35)	-.056 (-1.09)	.048 (0.64)	.096 (2.26)
		.003 (0.05)	.035 (0.61)	.025 (0.52)
Sales	.122 (4.42)	.009 (0.20)	.120 (2.05)	.123 (4.49)
		.094 (1.58)	.078 (1.67)	.101 (2.95)
Clerical	.064 (2.54)	-.035 (-0.96)	.105 (1.96)	.094 (4.59)
		.078 (1.78)	.081 (2.01)	.002 (0.09)
Service	-.076 (-2.90)	.009 (0.20)	.090 (1.55)	.042 (1.46)
		.171 (3.10)	.116 (2.37)	.110 (3.24)
Precision Production, Craft & Repairs	.113 (4.31)	-.019 (-0.45)	.082 (1.54)	.113 (5.09)
		.073 (1.41)	.107 (2.51)	-.033 (-1.14)
Transportation & Material Moving	.060 (2.04)	.012 (0.09)	.116 (1.38)	.129 (3.38)
		.209 (1.77)	.015 (0.21)	.061 (1.21)
Farming, Forestry, and Fisheries	-.021 (-0.36)	-.059 (-0.47)	.317 (1.69)	.139 (1.51)
		.155 (0.75)	.041 (0.28)	.037 (0.37)
Laborers	(excluded)	-.057 (0.97)	.100 (1.56)	.060 (2.36)
		.062 (0.84)	.181 (2.90)	.070 (2.39)

NOTE: Qualifying training--occupation interaction is listed first within category, then skill improvement training-occupation interaction is listed.

truck drivers, and farmers have returns under 5 percent. Since many features of formal training are controlled for, these differences must also reflect differences in specificity of training or heterogeneity.

Most of the coefficients of qualifying informal OJT are significantly positive, with managers, sales workers, precision crafts workers, truck drivers, and farmers being over 10 percent, suggesting either more heterogeneity in ability or quantity of training or more generality of training in these occupations. Returns to skill improvement informal OJT are not so high on average, with only sales workers and the services having returns over 10 percent and only two more significantly greater than 0.

In general, the services, sales workers, transportation and material moving workers, and farm workers had the highest returns to training, given that features of training were controlled for, whereas technicians had generally low returns. In all occupations, however, the return to one type of training or another was significantly positive. The occupations with the highest average returns (intercepts) also generally had the lowest returns to training.

Conclusion. This examination of the effects of training on earnings has found that the major categories of training (schooling, formal company training, and informal OJT) have significantly positive effects on earnings. However, among these, the returns to job-relevant schooling are lowest, especially for predoctoral schooling and skill improvement schooling, suggesting that the return to job-relevant schooling is not that much greater than that for more general education. These general results are fairly consistent across sex-race subgroups, although black males have greater returns in some categories. It also shows that returns to qualifying formal company training fall with experience, whereas returns to skill improvement schooling rise with experience. Finally, there are some significant differences in returns to training across major occupational groups.

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6.0 IMPLICATIONS AND POLICY RECOMMENDATIONS

John Bishop

6.1 Reasons for Underinvestment in On-the-Job Training

From the point of view of public policy, the most important conclusion from the preceding analysis of on-the-job training is that from society's point of view, employers and employees underinvest in general on-the-job training.[1] This occurs for four reasons:

- The worker's discount rate (the rate at which the worker can borrow and therefore trade off future consumption for current consumption) is considerably higher than the social discount rate (the interest rate on government bonds). This occurs because workers cannot borrow at reasonable interest rates to finance consumption while they invest in general OJT.
- The tax rates faced by the worker when the returns to the investment are being received are typically higher than the tax rates when the costs are being incurred.
- Other employers do not perceive accurately the quality of the general OJT received by the worker and, as a result, do not fully compensate the trained worker if he or she receives good training.
- If a minimum wage constraint is binding, the starting wage on a job will have to be higher than it would otherwise have been and this increases the cost of training and thus reduces its amount. A second impact of the minimum wage is that the rise in the starting wage is partially compensated by a fall in the wage rate in the posttraining period. This increases the quit rate, which in turn reduces the payoff to training and therefore the amount of training.

Evidence supporting these conclusions is discussed in the following sections.

High Borrowing Costs

Because of the fear of turnover, employers are not willing to pay for general training that is visible and useful in other firms. Since the employer will not pay for general training, it will be offered only to those workers who pay for it by accepting a lower wage during the training period than could be obtained elsewhere. The more intensive the training, the greater the required reduction in wages will be. Many workers are unwilling to accept a large reduction in their current standard of living, and, since they are unable to borrow at reasonable interest rates, they forego the investments in general on-the-job training. The government recognized long ago that people going to school needed access to low-interest, government-guaranteed loans. Workers investing in general on-the-job training have a similar need but are not eligible for such loans unless they happen to be part of a training program run by an accredited educational institution.

The Progressive Income Tax

Progressive income taxation tends to discourage investment in general on-the-job training. The worker's costs of investing in OJT is the lower wage he or she must accept during the training period. These costs are expensed in the year they are incurred, so if all individuals paid taxes every year and faced the same marginal tax rate every year, the tax system would have neutral effects on OJT investment. However, investments in OJT are typically made at a time when the individual has no tax liability or a lower-than-normal marginal tax rate and the benefits are received when earnings and marginal tax rates are higher. As a result, the after-tax benefits of an OJT investment are reduced more than the after-tax costs and this discourages such investments.

Transmitting Information about a Worker's General Skills

In the U.S. labor market, hiring decision makers have a very difficult time assessing the quality of the general human capital obtained from on-the-job training. This fact increases turnover, lowers wages, and lowers productivity. Since part of the reason for getting general training is to improve the worker's marketability with other employers, not recognizing the benefits of this training reduces the incentive to invest in general on-the-job training.[2] Doing an especially good job of training employees will benefit the trained workers when they leave the firm only if the firm develops a reputation for being a good trainer.[3] Past experience with the former employees of a firm is probably the primary determinant of a firm's reputation as a trainer. As a result, small firms, firms with very low rates of turnover, and firms that are new in the community are likely to be unknown quantities. Large firms that turn over a reasonable share of their trainees are likely to develop a reputation (good or bad) for the training that they provide. It is well known, for instance, that IBM and General Electric provide excellent training to their newly recruited junior executives. This positive reputation helps their separating employees find better jobs, and this in turn helps the firm recruit the best possible candidates when it is hiring. Even though a good reputation as a trainer forces them to pay higher wages in the post-training period, most firms have a strong interest in establishing such a reputation. The armed forces are aware of this, and thus they spend millions of dollars advertising the quality and civilian usefulness of their training.

The lack of full reward for improvements in general skills if one leaves one's current employer affects the incentives for the trainee to devote time and energy to learning general skills. The higher the worker's likelihood of leaving the firm, the lower is that worker's incentive to devote himself or herself to learning general (or specific) skills that are not immediately visible to other employers. This means that the underinvestment in general OJT is greatest for temporary and seasonal employees and for young people as a group.

The poor quality of the information about a job candidate's general skills and the resulting underinvestment in general training (both on the job and in schools) is a major institutional flaw of U.S. labor markets. Formal systems for certifying the competencies gained through on-the-job training exist in the United States, but they have not achieved the widespread usage they deserve. The apprenticeship systems of Switzerland, Austria, and Germany are probably the best examples in the world of a widespread and effective system of on-the-job training and competency certification. One of the most important features of these apprenticeship systems is the requirement that the apprentice pass written and practical examinations in all the skills that are part of that occupation's curriculum. The master/teacher must arrange for the apprentices to receive instruction at another firm or at a special employer-run school if training cannot be provided in all the skills that are included in the curriculum. The examinations are set and scored by a local committee of masters (skilled workers) and employers so the quality of the training provided by the firm and the master is put to a public test. Passing this apprenticeship exam is of benefit not only to the trainee, it is important to the masters as well, for both their reputation amongst their peers and their ability to recruit high-quality apprentices depends upon it. As a result, 90 percent of German apprentices remain at 1 employer for the full 3-year apprenticeship period, and 90 percent of these pass their test (on the first or second try). The apprenticeship systems of the English-speaking nations are based on time served rather than competencies achieved and are considerably less successful in standardizing and upgrading the training that occurs.

The examination at the end of the training process is the key to maintaining quality control. In the late 19th century, the Swiss educational/training system went through a period of crisis and self-examination not unlike that which is underway in the United States with the Nation at Risk report. The nation had to export to survive but the quality of workmanship was low and deteriorating. The Swiss assigned blame to their apprenticeship system and proceeded to reform it by ending apprenticeship based on time served and instituting written and practical examinations set by local committees of employers and workers. The high standards of workmanship for which Swiss workers are reknowned are not an inherent trait of national character but rather are the consequence of the institutions that teach, test, certify, and publicize this workmanship.

The Effect of Minimum Wage on Employer Training

A number of economists have argued that the minimum wage discourages on-the-job training of inexperienced and unskilled workers (Hashimoto 1982, Leighton and Mincer 1981). The reasons for expecting the minimum wage to have this impact need explanation.

Providing training to a new employee is costly. The new employee is not very productive at first, and other workers must take time away from their regular activities to give instruction to the new hire. Many of the skills that the new employee learns have application in other firms as well. To avoid losing the worker to another firm, the employer that is providing the training must raise the wage as the trainee's productivity increases. Jobs that offer training and the prospect of future wage increases are more attractive than those that do not. The competition for these jobs will enable employers offering general training to obtain workers at lower wage rates.

Minimum wage legislation, however, prevents wage rates from falling below the legislated monetary figure. Lacking the ability to get new employees to pay a major share of the costs of general training (by accepting a low wage during the training period), employers will adopt production technologies that minimize the skill requirements of the job. The evolution of the diner and the small, family-operated restaurant into franchised fast food operations using specially designed machines and prepackaged food is an example of how this is accomplished. By reducing the skills required to do the job, the employer shortens the time it takes for new employees to reach maximum productivity. The same people may have the job but they are taught less, and what is taught is useful only in that firm--not elsewhere. Opportunities for promotion are minimal and wage increases are small or nonexistent.

Although the theoretical case for the proposition that the minimum wage discourages OJT is strong, very little evidence of such an effect has been presented. Direct measures of OJT have not been available. Efforts to test this hypothesis have had to use indirect methods that have not yielded conclusive results (Hashimoto 1982).

If the minimum wage does effect investment in OJT, its effect will be visible in the jobs whose starting wages are at or below the minimum. Many of these jobs will have had to be redesigned to minimize training time and the development of general skills. This possibility was tested in an analysis of 1980 data on training obtained in the first wave of the National Employer survey (Bishop 1982). This survey contains two measures of inputs into on-the-job training--the time spent training the employee by management and the time spent by co-workers--and one measure of training output--the reported change in productivity of the worker. These measures make possible a more direct test of the impact of the minimum wage on OJT than has been possible previously. At the time of the first-wave interview in 1980, the minimum wage was $3.10 an hour. The new hire about whom the wage rate and productivity questions were asked was hired in either 1979 or 1978 when the minimum wage was $2.90 and $2.65 respectively. Dummies were defined for wage rates less than $2.75, wage rates between $2.75 and $3.05, wage rates between $3.05 and $3.15, and wage rates between $3.15 and $3.50. It was hypothesized that the first three of these dummies would have a negative impact on time spent in training and on productivity growth. The hypothesis implied a curvilinear relationship where, holding job requirements and worker credentials constant, jobs offering the least amount of training would be those paying at or below the minimum wage and those paying very high wage rates.

The empirical results are presented in table 6.1. As hypothesized, the continuous measure of the wage rates had a negative coefficient in all 3 equations, 2 of which were statistically significant at the 0.05 level on a one-tail test. All the coefficients on the dummies capturing the effect of the minimum wage were negative as hypothesized. Four of the 8 coefficients were statistically significant at the 0.025 level on a one-tail test. They imply that jobs paying $3.10 an hour offered 3.3 fewer hours of training by management (a reduction of about 15 percent) and 4.5 fewer hours of training by co-workers (a reduction of about 30 percent). The growth of the productivity index is 2 points lower (a reduction of about 15 percent).

TABLE 6.1

IMPACT OF THE MINIMUM WAGE ON ON-THE-JOB TRAINING

Variable	Training by Management during 1st month (hours)	Training by Peers during 1st month (hours)	Change of Productivity Index
Wage LT $2.75	-8.44 (2.26)	-5.44 (2.65)	-4.14 (2.70)
Wage $2.75 - $3.05	-2.99 (2.19)	-2.66 (1.34)	-2.89 (1.96)
Wage $3.05 - $3.15	-3.33 (1.34)	-4.52 (3.72)	-2.18 (2.43)
Wage $3.15 - $3.50	-1.43 (1.33)	- .10 (.80)	-1.47 (1.64)
Wage Rate	- .64 (1.94)	- .37 (1.24)	- .36 (1.64)

NOTE: Other variables included in the model were the sex, age, education, and previous relevant work experience of the new hire, establishment size, unionization, percent white collar, percent crafts, dummies for industry and subsidy program, average wage rate in the community, and a long list of job descriptors based on the job's DOT code. The productivity change regression had additional controls for tenure on the job. See chapter 8 of Bishop (1982) for a complete description of the data and models.

The hypothesis that the minimum wage reduces training was also tested using 1982 data on training investments and productivity growth. Both the wage of workers with 2 years of tenure and a dummy for that wage being at or below the legal minimum were added to models predicting the logarithm of the typical new hire's training intensity during the first 3 months of employment and the increase in productivity between the first 2 weeks and the end of the second year for the typical new employee. The models estimated had a complete set of controls for occupation, industry, and other characteristics of the firm. The results of these regressions are presented in table 6.2. In the training intensity equation, the coefficient on the dummy for the minimum wage is negative and highly significant. The results imply that when the minimum wage constraint is binding it reduces training intensity by 25 percent.

Productivity growth is lower as well. Coefficients on the minimum wage dummy are negative in both of two alternative specifications (an absolute growth of productivity specification and a logarithmic growth model), and it is significantly negative in the absolute change model. The magnitudes of the estimated impacts of the minimum wage are similar in both specifications. The results imply that because it lowers training binding minimum wage constraint is associated with lower productivity at the time of the interview by about 5 percent and reduces the growth of productivity by 12-17 percent.

Evidence of Underinvestment from the High Rates of Return to OJT

If there is underinvestment in general OJT, we would expect to find private rates of return to OJT to be very high. The studies that have estimated the return to OJT investments by workers find that rates of return are very high. For instance, after adjusting for inflation, the real rate of return to OJT investments by the worker was 12.6 percent per year for those who went to college and 19 percent for those who did not attend college (Rosen 1982). These rates of return are considerably higher than the real rates of return of about 4 percent on corporate bonds and of about 5 percent for schooling. Some estimate the rates of return to be even higher (Mincer 1974).

TABLE 6.2

THE DETERMINANTS OF THE TRAINING OF THE TYPICAL NEW HIRE

Variable	Intensity of Training First 3 Months		Productivity Growth			
			Absolute Change		Proportionate Change	
Job Characteristics						
Wage is at minimum wage	-.278***	(2.8)	-4.21**	(2.1)	-.047	(.9)
Wage after 2 years on the job	.015	(1.3)	.11	(.5)	.014**	(2.4)
Importance of vocational education	.349***	(6.3)	.80	(.4)	.015	(.3)
Specific vocational preparation	-.020	(.8)	.57	(1.2)	.026*	(1.9)
General educational requirements	.073	(1.2)	.38	(.3)	-.015	(.5)
Clerical	.302***	(2.8)	4.39**	(2.0)	.061	(1.1)
Sales	.620***	(4.2)	4.64	(1.6)	.331***	(3.0)
Retail sales	-.318**	(2.0)	-7.81**	(2.4)	-.281***	(3.4)
Professional	.121	(.8)	.15	(.0)	.016	(.2)
Managerial	.024	(.2)	-1.14	(.4)	-.033	(.4)
Service	.106	(1.1)	-2.07	(1.0)	-.046	(.9)
Crafts	.054	(.5)	-3.97**	(2.0)	-.130**	(2.5)
Proportion craft or white collar	.423***	(4.1)	8.42***	(4.0)	.266***	(4.9)
Log cost of machine	.054***	(3.0)	.21	(.6)	.016*	(1.7)
Hours per week	.019***	(5.5)	.03	(.4)	.001	(.7)
Temporary job	-.293***	(3.7)	-3.71**	(2.3)	-.096**	(2.3)
Trainee Characteristics						
Proportion under 25	.374***	(3.5)	4.59**	(2.1)	.148***	(2.6)
Proportion union	-.184	(1.6)	-5.63**	(2.5)	-.136**	(2.3)
Employer Characteristics						
Log establishment employment	-.210***	(2.7)	-3.45**	(2.2)	-.074*	(1.8)
Log employment squared	.034***	(3.1)	.79***	(3.6)	.017***	(2.9)
Log ratio firm/establishment employment	.046**	(2.0)	- .10	(.2)	-.001	(.1)
Employee growth during 1981	-.192	(1.1)	1.82	(.5)	.054	(.6)
Employee growth during 1981 if positive	.448*	(1.69)	-5.61	(1.0)	-.131	(.9)
Market Characteristics						
Log alter employers using same skills	-.050***	(2.8)	- .39	(1.6)	-.017*	(1.9)
Log labor market size	.036	(1.6)	- .48	(1.0)	.002	(.2)
Standard error or estimate	1.185		24		.623	
R squared	.155		.084		.090	

NOTE: The models also contained dummies for industry (construction-mining manufacturing, transportations-utilities, finance-services), the local unemployment rate, the growth rate of employment in the labor market, and the proportion white collar. T-statistics are in parentheses to the right of the coefficient.

*** indicates that the estimate is significant at the 1 percent level (two-sided),
** indicates that the estimate is significant at the 5 percent level (two-sided),
* indicates that the estimate is significant at the 10 percent level (two-sided).

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Our data also support a conclusion that total rates of return (combining both worker and employer benefits and costs) to OJT in the first few months of employment are extremely high. The employers interviewed in the 1982 survey report that new hires are 32 percent more productive on average in the 3d-12th week of employment than in the first 2 weeks. Since the training that produces this dramatic increase in productivity is occurring over the course of only 2 months, the calculated costs of this training are not likely to exceed 2 months of output from the new worker. If so, the average rate of return to this training exceeds 100 percent. Employers also reported that over the course of the next 21 months (up to the worker's second anniversary at the firm) productivity typically increases another 26 percent. Average rates of return on the training investments that produce this productivity gain are many times higher than the real rates of return to corporate bonds and schooling.

6.2 Policies to Encourage On-the-Job Training

The primary justification for public control and subsidy of schooling and public involvement in other forms of education and training is the fact that the individual who gets the education and training receives only part of its benefits. When deciding on the type and amount of education and training to undertake and how hard to study while at school, most individuals are taking only private benefits into account. The private benefits of an educational experience are many: the enjoyment derived from being a student or pleasing mom and dad, the higher after-tax income, the prestige and consumption benefits of having an education (or a job that requires heavy on-the-job training), the private benefits of improved health, and so forth. These private benefits account for only part of the total benefits to society of education and training, however. People who have received more or better education and training or who achieved more during the experience benefit others in society by paying higher taxes, by making discoveries or artistic contributions that benefit others in the society, by being more likely to give time and money to charity, by being less likely to experience long periods of hospitalization that are paid for by insurance or government, and in many other ways (Haveman and Wolfe 1983). Economists call social benefits such as these "spillovers" or "externalities." Private decisions will lead to an insufficient quantity and insufficient quality of education and training and insufficient achievement by students, unless public agencies intervene and partially subsidize the cost or add to the rewards. The appropriate amount of public subsidy is closely related to the size of the spillover or externality benefits of education and training (Hartman 1973; Mundel 1973).

Evidence has been presented in this study that on-the-job training produces spillover benefits just as schooling does. When an individual receives extensive, high-quality on-the-job training, they also benefit others in the society by paying higher taxes, by being less likely to require welfare and unemployment insurance, by being more likely to make scientific and technological advances, and by being more productive on their job (and not being compensated for it). In addition, labor market distortions, such as the minimum wage, lack of access to loans, and lack of certification of OJT, cause individuals and firms to choose less OJT and lower quality OJT than is desirable from society's point of view. Clearly, there is a need for the government to promote increases in on-the-job training.

How might government induce firms and workers to increase investments in general on-the-job training? Since the returns to training cannot be distinguished administratively from other labor earnings and profits, lowering the rates of taxation on these returns is not a feasible policy option. Policies that promote general on-the-job training either remove artificial barriers or subsidize the costs of the investment. Seven policy options are reviewed in this section:

- Lower turnover.
- Improve current systems of certifying the quality of on-the-job training.
- Allow jobs that offer considerable general training to pay wage rates below the legal minimum.
- Make workers who are undergoing a significant amount of general on-the-job training eligible for low-interest guaranteed student loans.
- Encourage public educational institutions to provide training at the work site that is customized to the needs of the particular employer.

- Subsidize a firm's training expenditures above a certain threshold.
- Subsidize the training of workers being prepared for certain critical shortage occupations.

Lowering Turnover

If rates of turnover were lower, the rate of return to both general and specific training would rise and the amount of such investments would increase. Particular efforts should be made to lower turnover in jobs that offer considerable training. This can be done by being more careful in hiring selections and by designing compensation schemes that induce people with low quit propensities to seek the job in the first place. The analysis of the time and care employers invest in making and selecting new employees found that they are more careful when filling jobs that offer or require considerable on-the-job training. When OJT was considerable and job security provisions substantial, more people were interviewed, references were more likely to be checked, and more time was spent per applicant. Nevertheless the total amount of time spent making hiring selections--about 10 hours per position filled--is very low and the crucial interview stage has been proven to have very low validity.

Hiring selections would be improved if less emphasis were placed on the interview and more emphasis placed on aptitude tests and job knowledge tests that examine the individual's prior knowledge of the occupation. Tests of general mental ability such as the GATB, ASVAB, and the SAT are highly valid predictors of both success in on-the-job training and later job performance. The primary reason these tests are such good predictors of job performance is that they measure the capacity and speed of learning new things. Job knowledge tests should also be used to make hiring selections both because they are good predictors of job performance and because they can be used to identify the skills and competencies the job candidate already has, so that the firm's training does not repeat material already known. Another approach to making better hiring selections is developing referral relationships with vocational teachers at local high schools, technical institutes, and colleges and giving preference to young people coming directly from a school experience over young workers who have been out of school a while and have been hopping from job to job.

Another way to reduce turnover is to design incentives into the job that (1) induce those who have high quit propensities to look elsewhere and (2) make it attractive to stay with the firm. This can be accomplished by setting lower wage rates in the training period and promising rapid increases in compensation and greater job security as the worker becomes more productive. Despite the fact that during the training period new hires are often less than half as productive as experienced workers, the entry wage in many American jobs is not far below the top wage for that job. The starting wage for apprentices in Switzerland and Germany is almost always less than half and sometimes less than one-fifth of the wage that will be received after the 3-year training period is completed. Their apprenticeship training is much broader and more thorough than training typically received by U.S. workers. New employees at Japanese firms also receive a much more comprehensive and well-rounded training. They start at a low wage but their wages increase rapidly with tenure at the firm. The U.S. labor market would be more efficient and total investments in OJT would be greater if firms competed for new hires by advertising the training that will be offered and the high wage rates that can be had in the future rather than by offering high wage rates for entry-level jobs.

Certification of On-Job-Training Accomplishments

Incentives to offer more and better OJT would be strengthened if employers advertised the training opportunities available at their firm, discussed the training to be received with the new hire on the first day, and awarded certificates for completion of formal training programs or achieving competence in a specific line of work through informal OJT. Such a system would probably result in both the supervisor and the employee taking the training function much more seriously. The certificate and the recognition it signified would be a source of pride to the worker and his family. The certificates would also signal to other employers what has been learned on the job and improve the worker's marketability if he or she should leave the firm.[4] The amount and quality of OJT would be better recognized by the labor market, resulting in better matches and more effective use of people's skills and stronger incentives to provide broader and higher quality training.

An industry wide system with common standards across firms would, of course, be the preferred way of certifying training experiences. Trade associations in banking and construction and a variety of other industries have sponsored the development and dissemination of competency tests that are necessary to create a truly uniform system of certification. Competency tests have also been developed by the National Occupational Competency Testing Institute, American Institutes for Research, and Departments of Education in Florida and Ohio (Chalupsky, Phillip-Jones, and Danoff 1981). Although most of these tests have been designed for certifying the vocational training provided by schools, they could be adapted for use in certifying apprenticeships and other forms of on-the-job training. The federal government could encourage the development of these competency certification schemes by awarding development contracts to trade associations. The highly developed systems of competency certification in Germany, Austria, and Switzerland that are administered by joint employer- union boards are examples of what is possible in the right setting.

Exemptions from the Minimum Wage

The minimum wage reduces on-the-job training in certain jobs. Exemption of jobs that offer considerable general on-the-job training would remove a barrier to greater OJT. At present jobs and internships that are part of an occupational training program run by an educational institution can be exempted from the minimum wage and often pay no wages for up to a year. This exemption should be extended to apprenticeships and other jobs that offer considerable training. Eliminating the minimum wage, however, might not end or dramatically reduce the underinvestment in general OJT, for the minimum wage is probably a binding constraint for only a small minority of jobs.

Low-Interest Loans for General OJT

Since lack of access to loans at reasonable interest rates is one of the most important reasons for worker underinvestment in OJT, solving this problem would automatically stimulate investment in general OJT. If there were an administratively practical way of defining populations of workers who are heavily investing in general OJT, such individuals could be made eligible for guaranteed student loans. The need for loans is greatest when training period wages are extremely low, so it would probably be desirable to limit eligibility to training slots or jobs which pay the minimum wage or less. To eliminate from eligibility the millions of secondary labor market jobs that provide little or no training, there would also probably be a requirement that the training prepare the individual for a job that paid at least 50 or 100 percent more than the minimum wage. At the completion of training the trainee would have to receive a certificate attesting to the skills acquired. Although such rules would limit the number of eligible jobs, there would also probably have to be a requirement that some minimum proportion of training period be spent in a training activity. This would require that some employers be audited regarding the actual time employees spent in training.

Customized Training

Since general OJT typically gets mixed together with specific OJT and both occur simultaneously with actual production, the primary difficulty in promoting general OJT is finding a practical way of measuring it. One way to promote on-the-job skill training without having to solve the measurement problem is for community colleges (or some other public agency) to establish cooperative training ventures with specific local employers in which teachers on the college's payroll or trainers contracted by the public agency provide training that meets that employer's specifications but is also useful at other firms. Many states and localities now offer this kind of aid to companies that open or expand plants in the community. The purpose of these cooperative efforts is not just to subsidize and promote on-the-job training. Proponents of customized training contend it serves as an inducement for new high-tech companies to locate in the state and as an aid to local firms struggling to keep up with fast-changing technology (New York State Education Department 1984). Another benefit of customized training is that the involvement of an educational institution facilitates the award of credentials that will make the skills gained more visible to other employers.

Publicly subsidized institutions are becoming increasingly important providers of skill training that is customized to a particular employer's needs. Not clear, however, is whether publicly controlled institutions are always the best provider of such training and whether, lacking the public subsidy, they would be effective competitors in this market. Often the best provider of specific types of customized training will be a private technical college or institute, an individual, a community-based organization, or another firm (e.g., the maker of equipment that is being installed at a firm). If these alternative providers are to be given a chance, the public funds set aside for customized training should be administered by a public agency that can select the best local provider and contract for the training in an expeditious manner. The responsibility for administering such a program could be assigned to the state department of education, as in New York; to the JTPA private industry councils; or to some other ad hoc agency.

Cooperative arrangements of this type are desirable, but they will probably not become general enough to solve the general problem of underinvestment in OJT. Cooperative arrangements will probably never account for a large share of on-the-job training for two reasons: limited budgets and the high costs of customizing the training to the employers needs, and difficulties inherent in determining who is to provide the training and how costs are to be shared. If customized training is to be attractive to firms, these costs--staff time, paperwork, and delay--must be kept to a minimum. New York State has demonstrated that it is possible to negotiate and contract for training quickly and at low cost. Nevertheless, when a firm has the option of using its own staff to do training, these costs will loom large and probably result in most firms choosing to do their own training.

Although the adoption of all five of the previously mentioned proposals would, in all probability, significantly increase OJT, each one addresses only one cause of the general problem of underinvestment. A more direct attack on the underinvestment problem through a direct subsidy of OJT necessitates a practical administrative mechanism for defining what is to be subsidized. The problem of measurement is a difficult one but it can be solved and two practical proposals for subsidizing on-the-job training are presented. The first of the proposals is a marginal subsidy of the firm's training expenditures. The second proposal is a subsidy of on-the-job training in certain critical shortage skills.

Marginal Training Subsidy

A marginal training subsidy (MTS) would offer a partial subsidy of a firm's training expenditures above a threshold level. The rate of subsidy or tax credit would be set between 10 and 33 percent. The training costs that would be eligible for subsidy would include payments to industry training funds, tuition reimbursements for job-related training, contributions of materials or staff time to vocational-technical institutions, the budgeted costs of the firm's formal training of new and continuing employees, and certain costs for informal training of new and upgraded employees.[5] Although the measurement of the costs of informal training is difficult, it must be attempted if choices between formal and informal training are not to be distorted.[6] The subsidizing costs of informal training would be limited to trainee time and trainer time during the first year of employment or during the first 3 months before or after a major promotion and change in job responsibility. If the training is formal, certain additional expenses--books and materials, rental of teaching machines and equipment or office space dedicated entirely to training, and payments to training vendors--would be eligible for subsidy. Formal training would be subsidized regardless of length of tenure or whether the worker received a promotion.

Participating companies with more than 100 employees would be required to have a training advisory committee with worker representation. At the outset of the training the trainee would have to be given a written description of the purposes and nature of the training. At the conclusion of the training program or the firm's fiscal year, the employer would be required to award each trainee a certificate describing the number of hours of formal or informal training, skills taught, and the competence achieved.

The threshold that must be exceeded before a subsidy or tax credit would be paid would be equal to 10 percent of the firm's or establishment's wage payments to employees with less than 1 year of tenure at the firm plus 1.5 percent of wage payments to all other employees. The threshold is higher for firms with many new employees because (1) new employees tend to receive more training than continuing employees, and (2) the costs of informal training are subsidized only during the first year on the job and for a short period after a promotion. A subsidy above a threshold has some important advantages over an obligation to spend a minimum amount on training (as currently in operation in France):

- Firms that are big trainers (and therefore probably efficient trainers) of skilled workers would always face an incentive to expand their training.
- In France, where there is an obligation to spend 1 percent of wage bill on training, the great majority of employees work at firms that exceed their obligation to spend, so at the margin, there is no public encouragement of additional training for the majority of French workers. A subsidy above a threshold avoids this problem.
- Paper work is reduced because most firms would not apply for a subsidy in most years. Year-to-year variations in training expenditures are likely to be large at small firms. Such firms would most likely spend above the threshold only in years in which there is a major expansion of employment or the installation of new equipment.
- Employers who feel that the administrative burdens of the subsidy are too high are free not to participate.

All employers--profit making, nonprofit, and governmental--should be eligible for the marginal training subsidy if their training expenditures exceed the threshold defined for their organization.[7] In order for incentive effects to be maximized, employers must feel they are assured a larger subsidy payment if they increase their training investment. Together these two considerations imply that the MTS should be administered as a subsidy entitlement, as a tax credit against a broad-based tax on the firm's wage bill like Federal Unemployment Insurance Tax or social security tax, or as a tax credit against income taxes that can be sold to other firms.[8] The MTS would be financed either out of general revenue or a special training tax on the wage bill of all employers. In order to give firms time to set up the accounting procedures to record training expenditures, it would be phased in at least a year after the legislation is passed.

The MTS has a number of important advantages:

- The social benefits of on-the-job training are probably just as large as the social benefits of occupationally specific training provided by schools. The MTS would create an incentive for firms and workers to generate more of such benefits and would reduce currently prevailing distortions of the choice between these two modes of providing occupationally specific training.

- Since the employer pays 67-90 percent of the cost of training, there is always an incentive to be efficient.
- The choice of which jobs to train for and how to do the training is made by the employer, not by a school or government official or the trainee. The employer is the person best able to project the firm's future need for skilled workers and to select the best method of training for those skills.
- The certificates awarded at the end would probably be a source of pride for employees. By signalling to other employers what had been learned, the certificates would improve the trainees' marketability.
- The inclusion of the costs of informal training in the definition of subsidizable training expenses is fair-to-small business and reduces the tendency of the subsidy to distort choices between formal and informal training. Altough the MTS is not directly targeted to the unemployed dislocated worker, it will nevertheless reduce unemployment. The MTS reduces unemployment in two ways:

  - It encourages firms to hire and train new workers and to retrain rather than lay off workers whose skills are becoming obsolete.
  - It encourages the firm to expand the supply of skilled workers rather than engage in a bidding war for the limited supply of already trained workers, thus producing an acceleration of inflation.
- The MTS should discourage turnover. A firm with high rates of turnover will have a higher threshold and will as a result receive a smaller subsidy payment.

The MTS has as its objective expansion and intensification of on-the-job training. Only 2 small reforms of current practice are proposed--setting up training advisory committees at firms with more than 100 employees and providing trainees with a certificate describing the training that has been received.[9] All the really important decisions--who is to be trained, what is to be taught, and how it is to be taught--are made by the employer and to a lesser extent by the worker. Workers influence these decisions by bidding for jobs that require training, by selecting an employer who provides the desired training, and by the commitment that is given to learning the material that is presented.

Employers and workers probably invest over Ω100 billion of time and resources in formal and informal on-the-job training each year. Consequently, covering all employers and all kinds of training means costs can be kept down only if the subsidy rate is set relatively low, the definition of subsidizable expenditure is restrictive, and the threshold is set relatively high.

A Critical Skills Training Incentive (CSTI)

An alternative approach to promoting more private investment in on-the-job training is to target certain critical occupations that are experiencing severe shortages. A subsidy would be offered for training newly hired and transferred employees in a few selected occupations.

Selecting skills for which to provide training incentive. Legislation would restrict the subsidy to a limited number of industries that currently export a major share of their output or are service firms that provide specialized high-tech services.[10] To be eligible for a training subsidy, an occupation or skill would have to involve considerable initial on-the-job training, be required at many firms, and be in shortage. The determination of whether an occupation is in shortage would be based on current data on changes in relative wage rates, changes in vacancy rates or newspaper advertising if available, and recent and projected growth of demand for the skill.[11] The Department of Labor would be given a fixed budget and would select a limited number of skilled jobs for which training subsidies would be available.

Once an occupation had been selected as a potential candidate for subsidy the Secretary of Labor would appoint an industry-labor committee to make recommendations regarding the definition of the critical skill, the competencies that a trained individual would be expected to have, and possible mechanisms to ensure that subsidized trainees achieve these standards. The Department of Labor would do a small survey of the costs of training and the length of the training period that would serve as a basis for calculations for median training cost.[12] The Secretary of Labor would be empowered to make competency certification (under the auspices of a multiemployer or union umbrella organization) a part of the mechanism for defining eligibility for a critical skills training subsidy.[13]

Administration of the training incentive. Application for a subsidy of a particular trainee must be made within 1 week of the start of the training (within 1 week of the date of beginning work in the case of a new hire).[14] The requirement of immediate application for the training subsidy has three purposes: (1) the firm is forced to be aware of the subsidy when it begins the training, which maximizes the subsidy's incentive effect; (2) it allows the Department of Labor to monitor continuously the number of trainees its program has stimulated and to project future costs and the fullfillment of its goals; and (3) for the firm, it locks in the terms and conditions of subsidy that prevailed at the date training was commenced. If the Department of Labor determines that more or less training is being undertaken than was needed or budgeted, it has the right without advance notice to restrict or liberalize the definition of subsidizable jobs skills, lower or raise the training cost allowance, or end that occupation's eligibility. Changes in rules would apply to all training programs begun 1 week or more after the announcement of the change.

There would be no limit to the number of trainees for which an employer could be subsidized, and the firm would not have to obtain advance agreement from the department as to this number. The employer would only have to certify (1) that the training provided resulted in the worker's attaining the critical skill, and (2) that the trainees did not have that skill prior to the training. This certification would be audited on a random basis.[15] Workers who complete training would be awarded a certificate attesting to the skills they have achieved.

The CSTI has a number of attractive features:

- It is limited in scope to occupations in critical shortage.
- Great flexibility is given to program administrators. (This is essential because the CSTI is a new concept and it must respond quickly to the changing needs of the economy.)
- Workers who complete training are awarded a certificate that describes the skills they have gained.
- The firm always faces a marginal incentive to expand its training of targeted skills. It does not have to get prior agreement from Department of Labor about how many people to train (an administrative hassle that would be a major barrier to participation).
- The firm is given an incentive to retain the workers it trains.

- Despite the almost "entitlement" nature of the training subsidy, its total cost is capped by the monitoring of usage and Department of Labor ability to lower subsidy amounts and tighten eligibility.
- A sunset provision automatically ends a skill's eligibility for subsidy.
- Costs could be further reduced by requiring that firms already employing people in the targeted skilled occupations exceed a given level of training before being eligible for subsidy. It could be assumed that in the normal course of events such firms would have to replace 10 percent of their stock of workers with the targeted skills anyway. The subsidy could be paid for trainees above this threshold.
- The firm's administrative costs are kept low. The firm does not have to calculate and report how much it is spending on training.
- Eligibility for subsidy is a function of an output--the number of people trained for certain specific jobs--not a measure of input. This creates a strong incentive to be as efficient as possible in doing the training.

The Critical Skills Training Incentive has some important drawbacks, however. Its success depends upon the wisdom and timeliness of the selection of skills for which training subsidy is provided. Experience with federally funded graduate fellowships should remind us how difficult it is for government to forecast future demand for a specific skill and implement decisions to extend or withdraw training subsidies in a timely manner. Graduate fellowships were originally targeted to a few shortage fields thought to be critical to national defense. However, other fields campaigned to be included and new programs were started until almost every field of study was included in at least one agency's fellowship program. The number of fellowships expanded even after the shortages of Ph.D.s in the field turned into a surplus. The CSTI has features--the sunset provision, great administrative flexibility, and a fixed budget--that are intended to prevent a recurrence of the poor timing that characterized the graduate fellowships programs. There is always the possibility, however, that the projections of future demand will be wrong or that politics will result in the wrong occupations being selected and that the selective nature of the training incentive would increase rather than decrease market distortions. For this reason, the MTS seems to be the preferred mechanism for promoting on-the-job-training.

NOTES

1. If the interest rates facing employers are higher than the social discount rate, there will also be underinvestment in specific training. The degree of underinvestemnt in specific training is considerably smaller than the underinvestment in general training.

2. Lack of information about the quality of general OJT received can increase investment in general OJT only under the very unlikely circumstances of very high retention rates and large differentials between the rates at which employers and employees trade off present before-tax income for future before-tax income. Under these circumstances the employer's desire to invest in general training may be stronger than the worker's desire. Because the wage will have to be increased by an equivalent amount, employers cannot benefit from (and therefore do not pay for) general training that is visible to other employers. Consequently, as such training becomes more visible to other employers, the calculus that determines the amount of training shifts to give greater weight to the very high discount rates faced by the worker, possibly reducing investment in general training. The condition that would have to be satisfied is that the retention rate would have to be equal to or greater than the ratio of the firm and worker discount rates. Even if the worker were to face yearly interest rates that were double the firm's rate (e.g., 30 percent rather than 15 percent), the retention rate would have to be above 85 percent. Retention rates for the first year at a job are seldom above 50 percent and average yearly retention rates for all employees new and old seldom exceed 85 percent. Yearly retention rates of employees who have been at the firm for many years may exceed 85 percent, but these more mature workers will typically have better access to capital markets than younger workers and face a tax regime that is neutral to OJT.

3. Well-trained employees who leave the firm that provided the training may benefit if their new employer eventually learns of their greater-than-anticipated productivity and makes later adjustments to the wage or bases a promotion on it. In the model just analyzed, high renegotiation costs prevent such adjustments from occurring at the first employer. If a third period were added to the model and retention in the second job modeled the same assumption of high renegotiation costs, it would prevent the worker from benefiting from better-than-expected training in the second job. If one were to relax the assumption that posttraining wage rates are prespecified and analyze a multiperiod model, the size of the distortion to training investment decisions would be reduced, but it would not disappear. Productivity is measured with error so one could never expect the new employer to perceive the full value of the worker's greater-than-anticipated training. Furthermore, other employers remain ignorant of greater-than-anticipated productivity. To all intents and purposes this greater productivity is specific to the firm, so the worker will only receive a small share of this greater productivity in higher wage rates.

4. Such a change clearly makes the worker better off. General training would be recognized better and new equilibrium would result with higher wages after training and lower wages during training. The firm would be able to lower the starting wage by enough to ensure that it benefitted as well.

5. To ensure that only training gets subsidized and not vacations or motivational sales meetings, subsidizable expenditures might be defined to exclude: (1) travel to a remote site other than the company's national or the appropriate regional headquarters; (2) housing and food expenses of more than $100 a day; (3) costs of training nonemployees, part-time employees working less than 50 hours a month, or employees for whom more than 50 percent of compensation comes from commissions; and (4) payments to speakers or presenters of a training session of more than $100 or $200 per contact hour, whichever is higher. The costs of developing a training package or system for use in training one's own staff would be an allowable expense.

6. A trainee would be considered to be engaged in formal or informal training if he or she is receiving group instruction, being instructed by a computer, reading manuals or instruction booklets, watching others do the work, or being shown the work. A trainer's, supervisor's, or co-worker's time would be considered to be engaged in a training activity only if 100 percent of the trainer's attention is devoted to the training purpose. If any output is produced during a training activity, it would have to be given to the trainee, discarded, or given away. The following tests could be used to define a promotion for purposes of calculating subsidizable training expenses: there would have to be a new job title, noticeably different job duties, a wage increase of at least 6 percent above the standard seniority or cost of living increment, and the individual could not have held that particular job before. In order for new employee training to be subsidizable, it would have to be associated with a wage increase by the end of that year of at least 10 percent over and above the rise in the cost of living.

7. To ensure that employers who receive an MTS subsidy were aware of the program at the time, it might influence their behavior if it could be required that the employees make a preliminary application before July 1 of the calendar year for which a subsidy is sought.

8. If the MTS is a subsidy, subsidy payments would be taxable income. If the MTS is a tax credit, the firm would have to reduce its reported social security or FUTA tax payments by the amount of the tax credit.

9. To the extent that the accounting rules used to distinguish training activities from production activities affect the way training is conducted, this is an unfortunate unintended consequence of the necessity of defining a dollar quantity of training expenditure for each firm.

10. Examples might be communications, machinery, instruments, chemicals, pharmaceuticals, electronics, computer service, and R&D laboratories.

11. For a skill to be eligible, both recent and projected rates of growth would have to be high. Projections of future growth should be based on a methodology that can be updated on a quarterly basis and that uses contemporaneous market signals (such as current or forward prices of the industry's product, new orders, or current industry sales or employment) to project future employment. The methodology must be capable of giving timely warning of industry turnarounds like the one that occurred in 1981 in oil drilling and exploration. A projection of rapid growth would be sufficient on its own (in

the absence of high past rates of growth) only if the evidence is particularly strong (e.g., Congressional passage of obligational authority for a huge multiyear contract). Where classroom training at schools or colleges substitutes for OJT, information on the number of graduates of such programs (recent and projected) would have to be compared to growth of demand.

12. The survey would not be very costly and would not take long, once a sample of employers who have trained such workers was obtained. Although visits to establishments by specialized staff would be the preferred mechanism, it could be done over the phone. A telephone interview approach to measuring on-the-job training costs for specific jobs has been developed by the National Center for Research in Vocational Education and implemented by the Gallup Organiza- tion at a cost of less than $75 per interview. The training costs that would be measured by this survey would include--

- payments to outside vendors such as a training institution,
- depreciation on machinery devoted 100 percent to training,
- time of specialized training personnel that is spent in contact with the trainee or preparing lessons,
- time of supervisors or co-workers spent giving formal or informal training to the nonworker above a 40 hour minimum, and
- time of the trainee that is spent in a formal or informal training activity that is not directly productive.

The survey would also serve as a basis for developing an operational definition of the job or skill for which training subsidies would be provided and of the levels of the skills. The results of the survey would be reviewed by DOL staff and the industry labor committee. DOL staff would make a formal recommendation to the Secretary that the advisory committee could endorse or take exception to as it wished. Training costs allowed in future years would be indexed to the economy's average hourly wage, so the survey would only need to be done once.

13. Systems for competency certification currently exist in construction, telecommunications, banking, and a variety of other industries. In some industries and occupations, an existing system(s) could be adopted "as is" or modified; in other industries and occupations, a new system would have to be developed. Since an occupation is eligible for a critical skills training subsidy for only a limited period, a judgement would have to be made as to whether the benefits of competency certification would outweigh the inevitable costs and delays that such a requirement would impose. In addition, in certain fast-changing fields codifying what must be learned in this way might not be desirable. There would be an expectation that the organization sponsoring the competency certification would continue the service after the end of the period of the occupation's eligibility. Conditioning the CSTI on the existence of competency certification would tend to encourage industry groups seeking designation of one of their job or skills as a critical skill to create a certification process for that job.

14. The application form could be quite simple, requiring only the name and social secruity number of the trainee, employer ID number, the training establishment's name and address, the firm's name and address, the skill for which training is being provided, the trainee's wage, and a description of the job (including its wage) for which he or she is being trained.

15. An advance opinion as to the eligibility of a proposed training program (binding on DOL) would be available to employers who request it. The calculated amount of subsidy would be paid in equal semiannual installments over the training period that has been established for that skill. If the worker is employed at the firm for less than the full training period, the subsidy payment would be prorationed for the period he or she was at the firm. The payments would be taxable income. Training establishments would submit semiannual bills to DOL for the subsidy payments due to it. The payment would be made to the training establishment (even when that establishment is part of a multiestablishment firm) because auditing would be carried out at the establishment level and because the payment then shows up in the right place in multiestablishment firms with divisional profit centers.

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